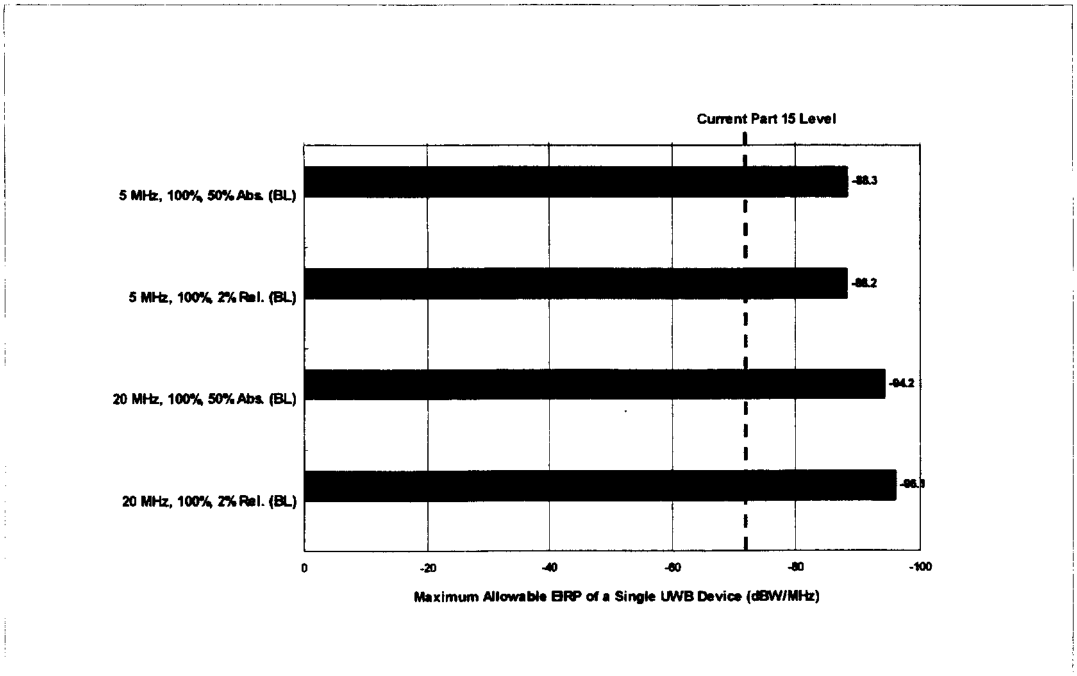

Figure 3-4. Analysis Results for Terrestrial Operational Scenario: Narrowly-Spaced Correlator Receiver and Single UWB Device (Noise-Like UWB Signals)

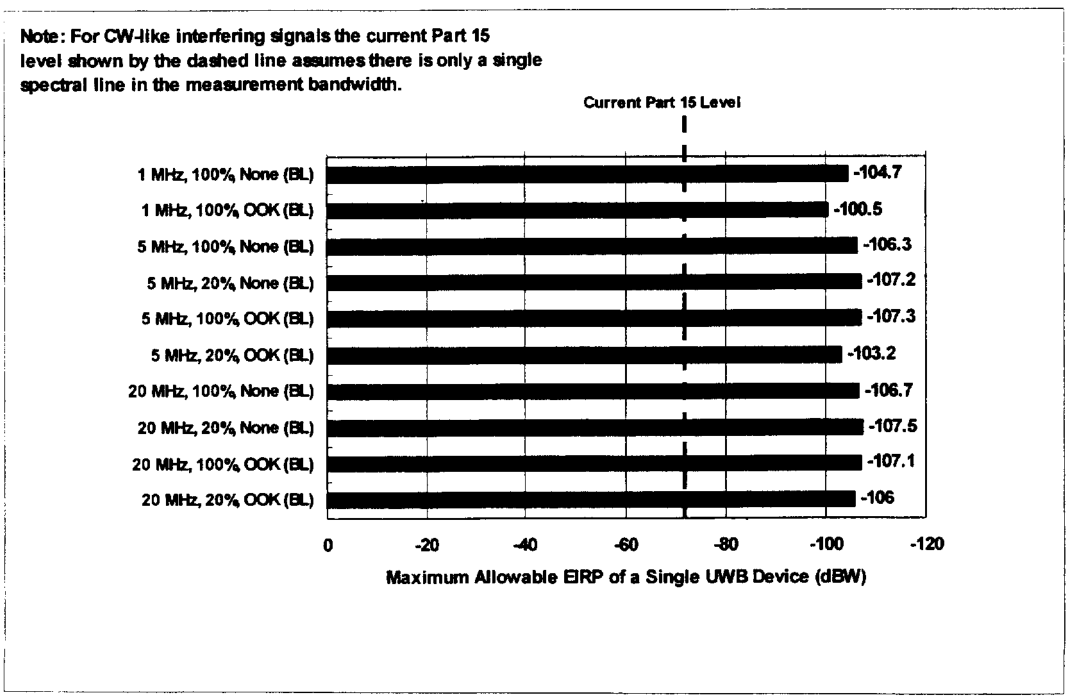

Figure 3-5. Analysis Results for Terrestrial Operational Scenario: Narrowly-Spaced Correlator Receiver and Single UWB Device (CW-Like UWB Signals)

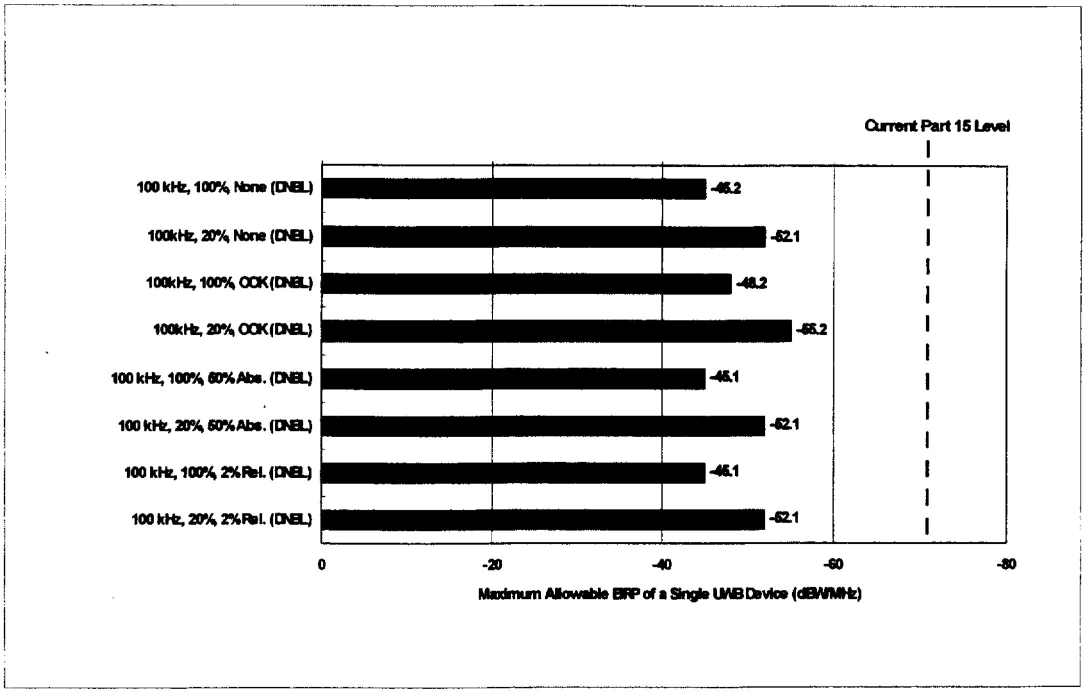

Figure 3-6. Analysis Results for Terrestrial Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (Pulse-Like UWB Signals)

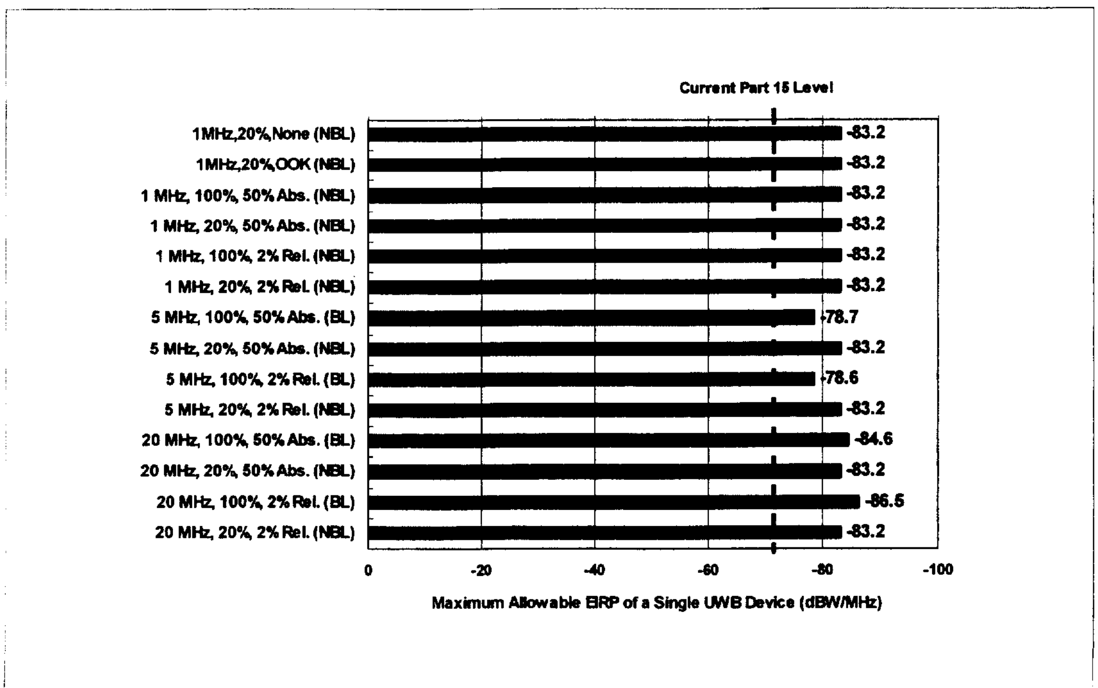

Figure 3-7. Analysis Results for Terrestrial Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (Noise-Like UWB Signals)

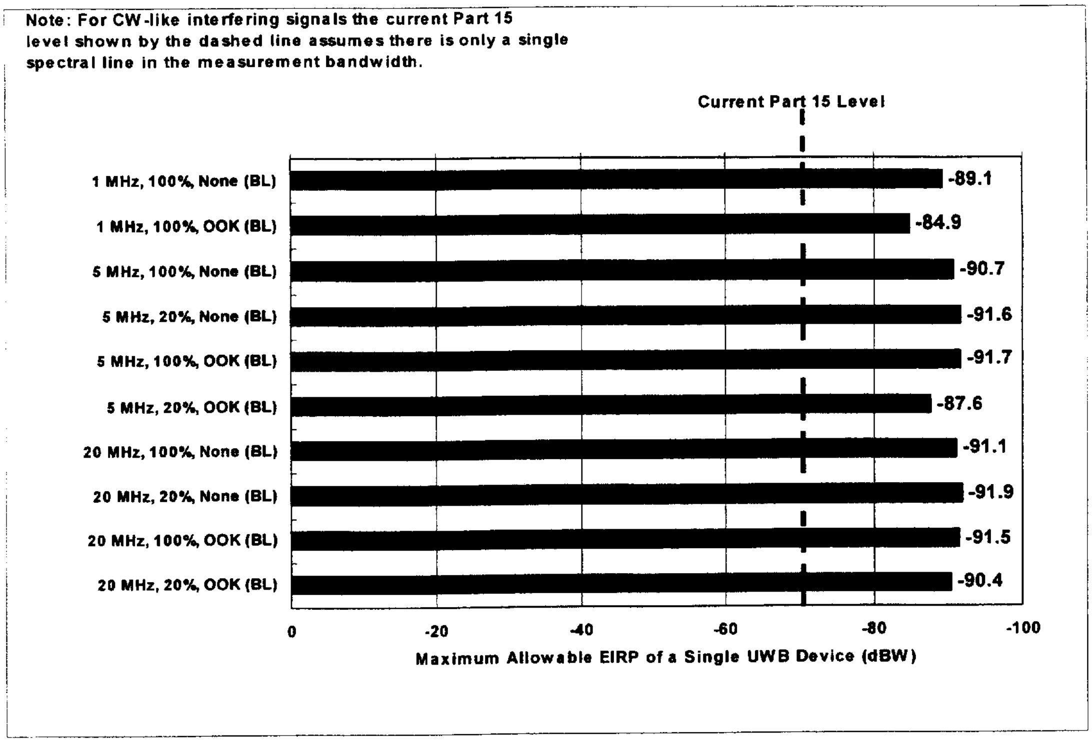

Figure 3-8. Analysis Results for Terrestrial Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (CW-Like UWB Signals)

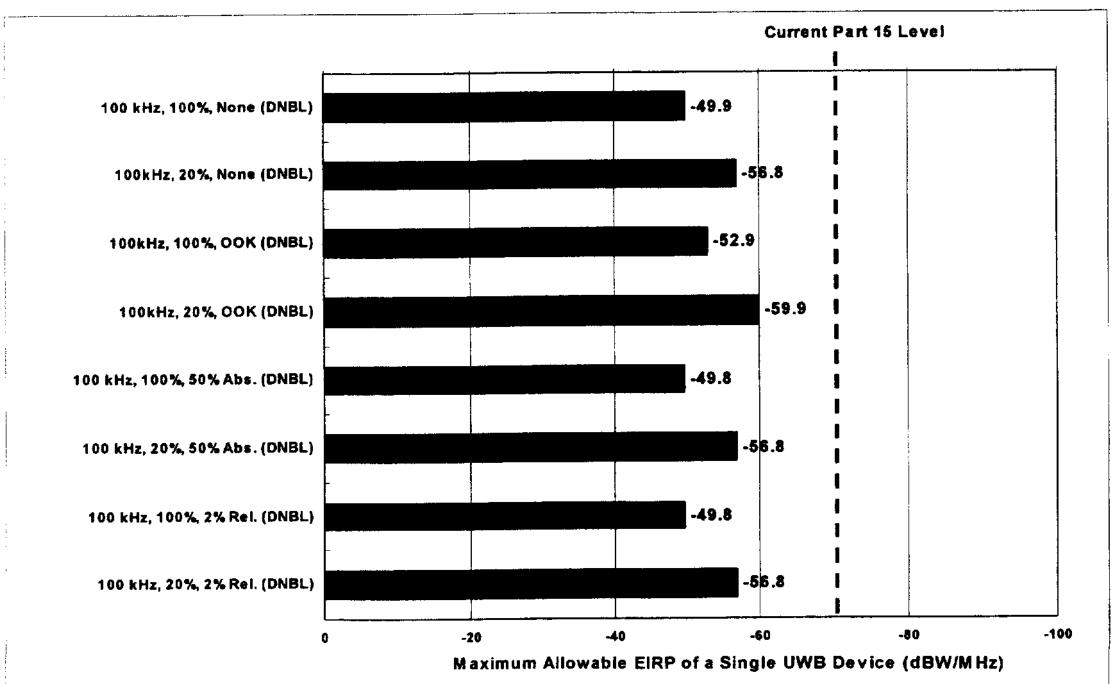

Figure 3-9. Analysis Results for Terrestrial Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (Pulse-Like UWB Signals)

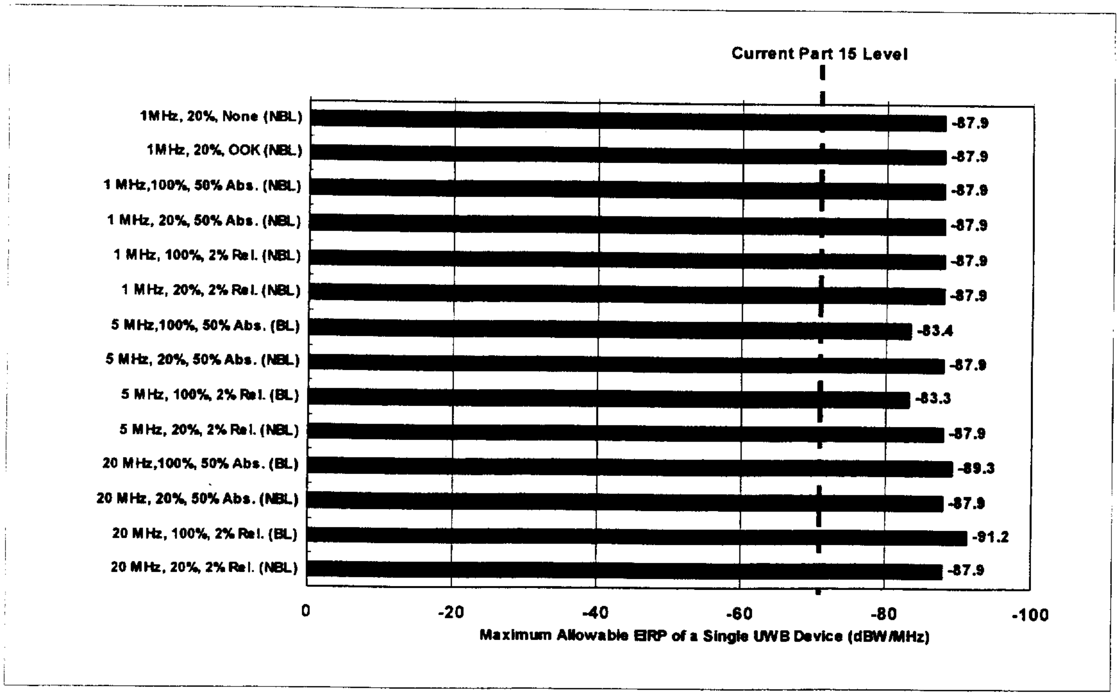

Figure 3-10. Analysis Results for Terrestrial Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (Noise-Like UWB Signals)

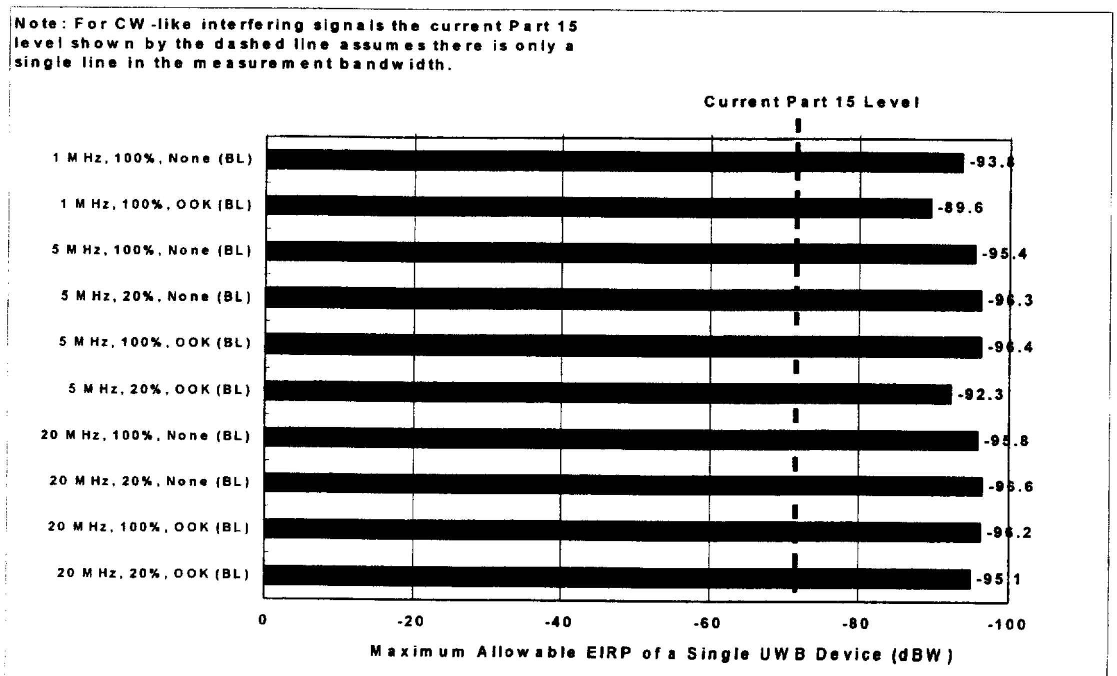

Figure 3-11. Analysis Results for Terrestrial Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (CW-Like UWB Signals)

3.3.2 Maritime Applications

In the operational scenarios for the maritime GPS applications, the narrowly-spaced correlator receiver architecture is considered. The analysis results for the narrowly-spaced correlator receiver architecture are given in Figures 3-12 through 3-23. Two antenna locations for the maritime use of GPS receivers were analyzed. The operational scenarios are designated as Maritime Operational Scenario I and II. The operational scenarios considered multiple-entry UWB device interactions as well as indoor and outdoor UWB device operation. The values of maximum allowable EIRP shown in Figures 3-12 through 3-23 are for a single UWB device and are based on average power.

The values of maximum allowable EIRP that are required to protect the narrowly-spaced correlator receiver architecture considered in the maritime application operational scenarios will vary depending on the UWB signal parameters and whether the UWB devices are used indoors or outdoors. The analysis results for the operational scenarios associated with maritime applications can be discussed in terms of the characterization of the UWB signal interference effects. As shown in Figures 3-12, 3-15, 3-18, and 3-21, the values of maximum allowable EIRP for the UWB signals that have been characterized as causing pulse-like interference range from -39.3 to -26.6 dBW/MHz for indoor UWB device operation and from -45.7 to -34.9 dBW/MHz for outdoor UWB device operation. Figures 3-13, 3-16, 3-19, and 3-22 show that for the UWB signals that have been characterized as causing noise-like interference, the values of maximum allowable EIRP range from -70.6 to -60.1 dBW/MHz and from -77 to -68.4 dBW/MHz for indoor and outdoor use of UWB devices respectively. Figures 3-14, 3-17, 3-20, and 3-23 show that for the UWB signals that have been characterized as causing CW-like interference, the values of maximum allowable EIRP range from -76 to -66.4 dBW for indoor UWB operation and from -82.4 to -74.7 dBW for outdoor UWB device operation.

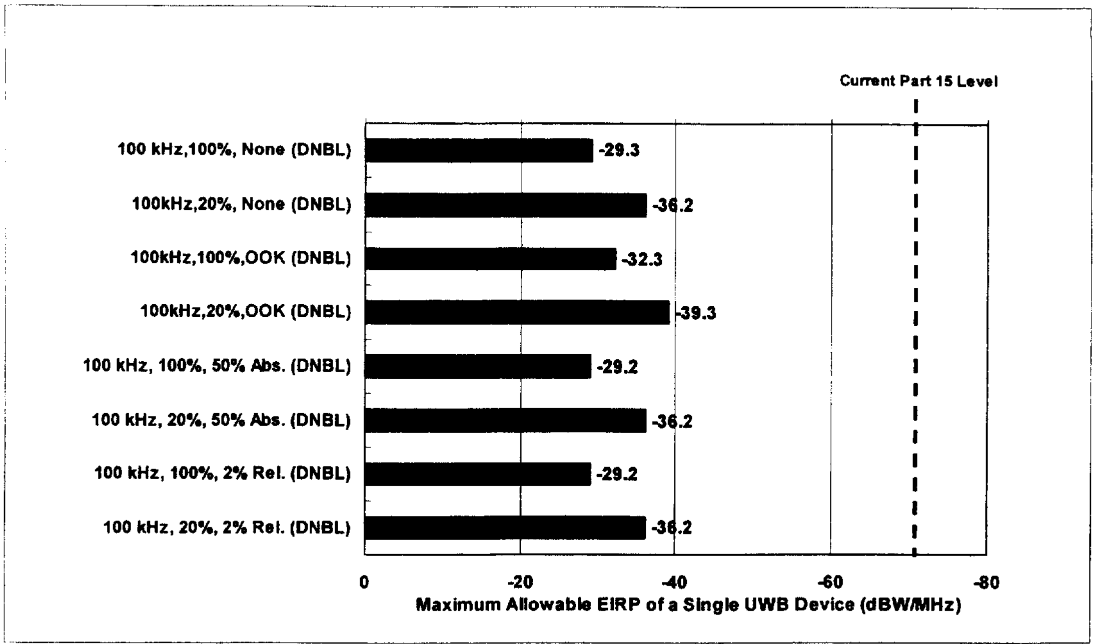

Figure 3-12. Analysis Results for Maritime Operational Scenario I: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (Pulse-Like UWB Signals)

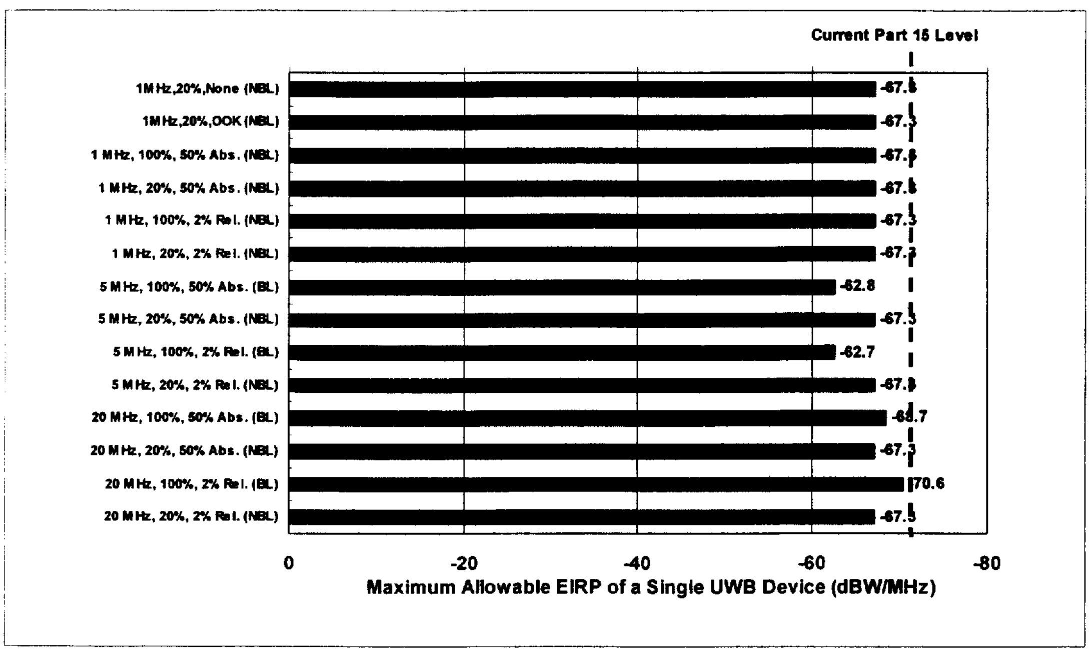

Figure 3-13. Analysis Results for Maritime Operational Scenario I: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (Noise-Like UWB Signals)

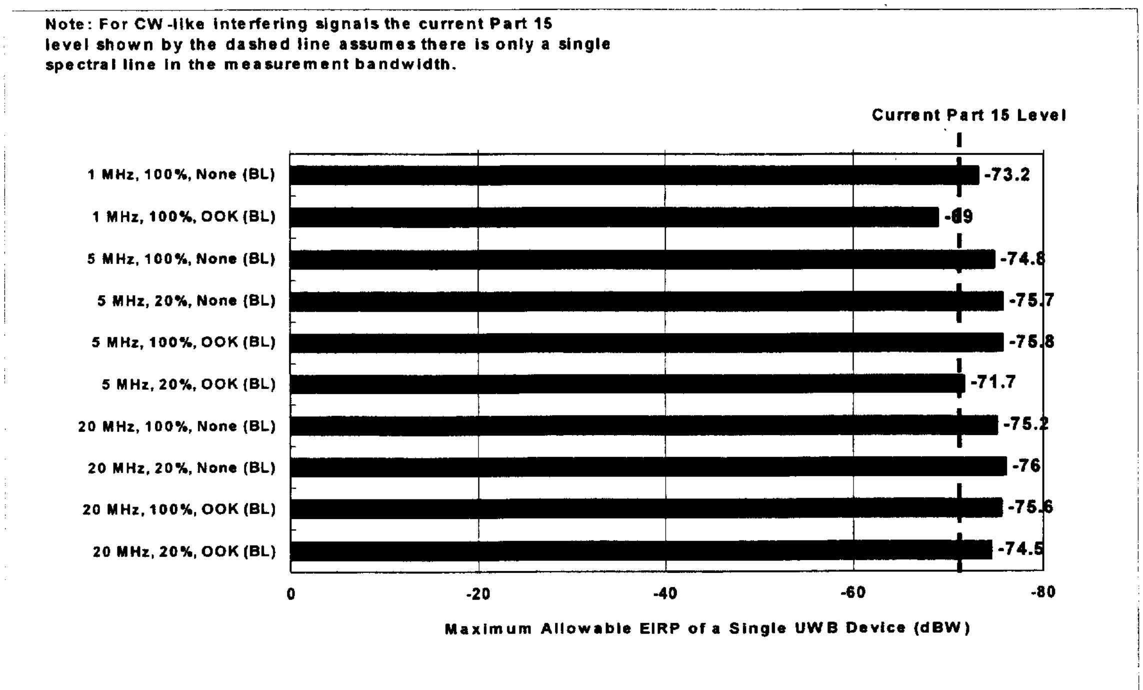

Figure 3-14. Analysis Results for Maritime Operational Scenario I: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (CW-Like UWB Signals)

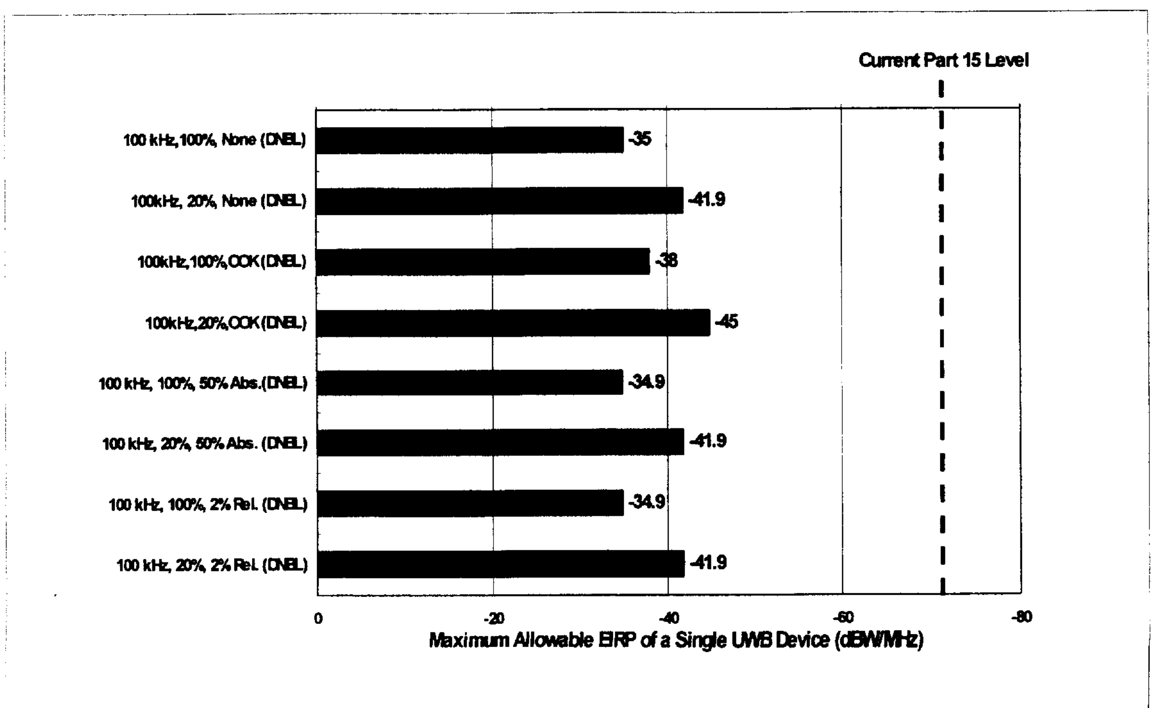

Figure 3-15. Analysis Results for Maritime Operational Scenario I: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (Pulse-Like UWB Signals)

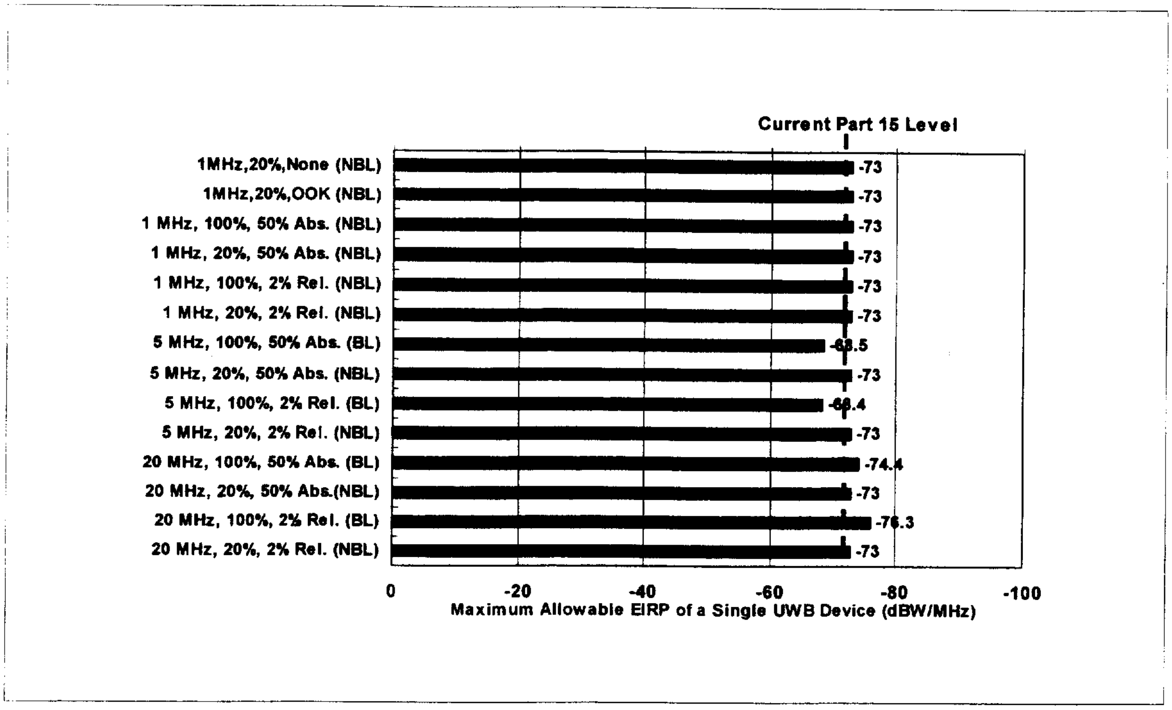

Figure 3-16. Analysis Results for Maritime Operational Scenario I: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (Noise-Like UWB Signals)

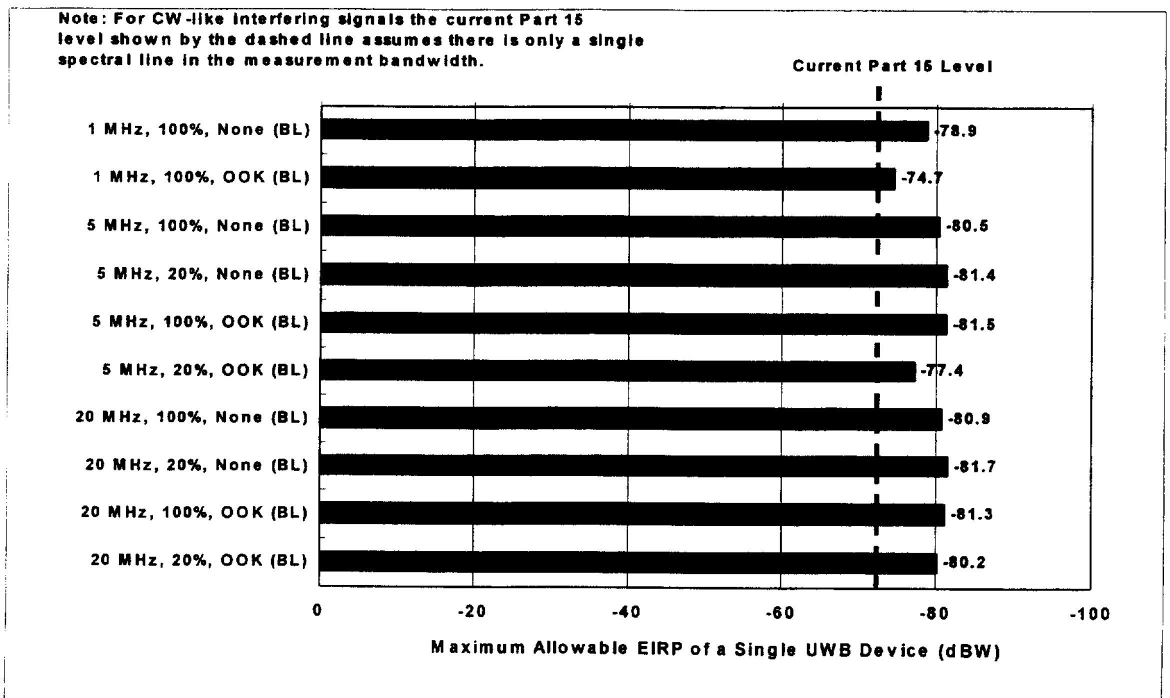

Figure 3-17. Analysis Results for Maritime Operational Scenario I: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (CW-Like UWB Signals)

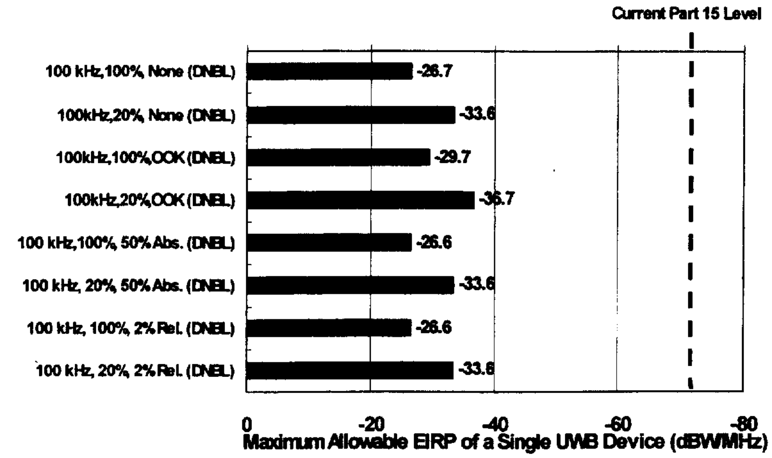

Figure 3-18. Analysis Results for Maritime Operational Scenario II: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (Pulse-Like UWB Signals)

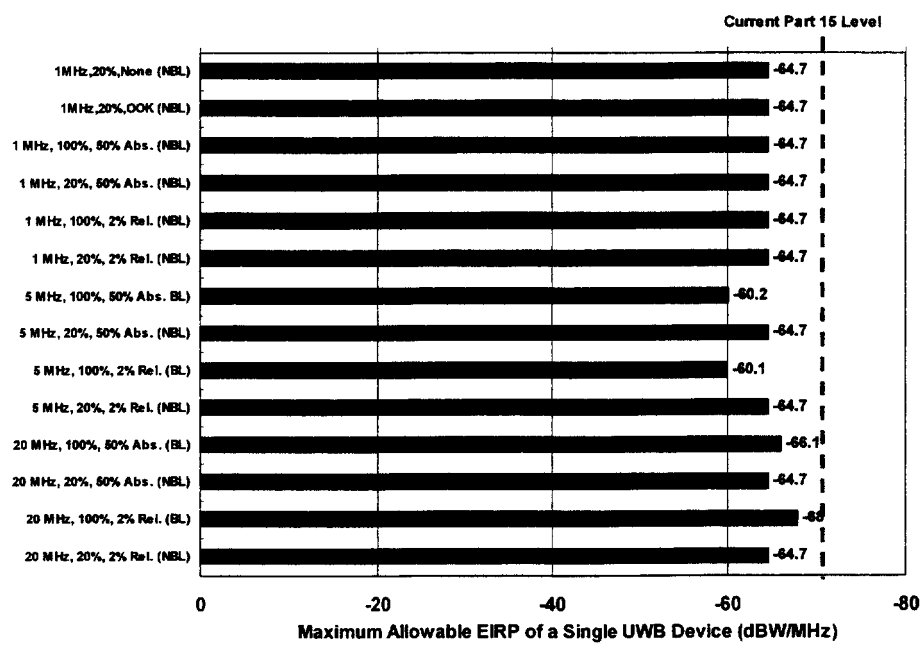

Figure 3-19. Analysis Results for Maritime Operational Scenario II: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (Noise-Like UWB Signals)

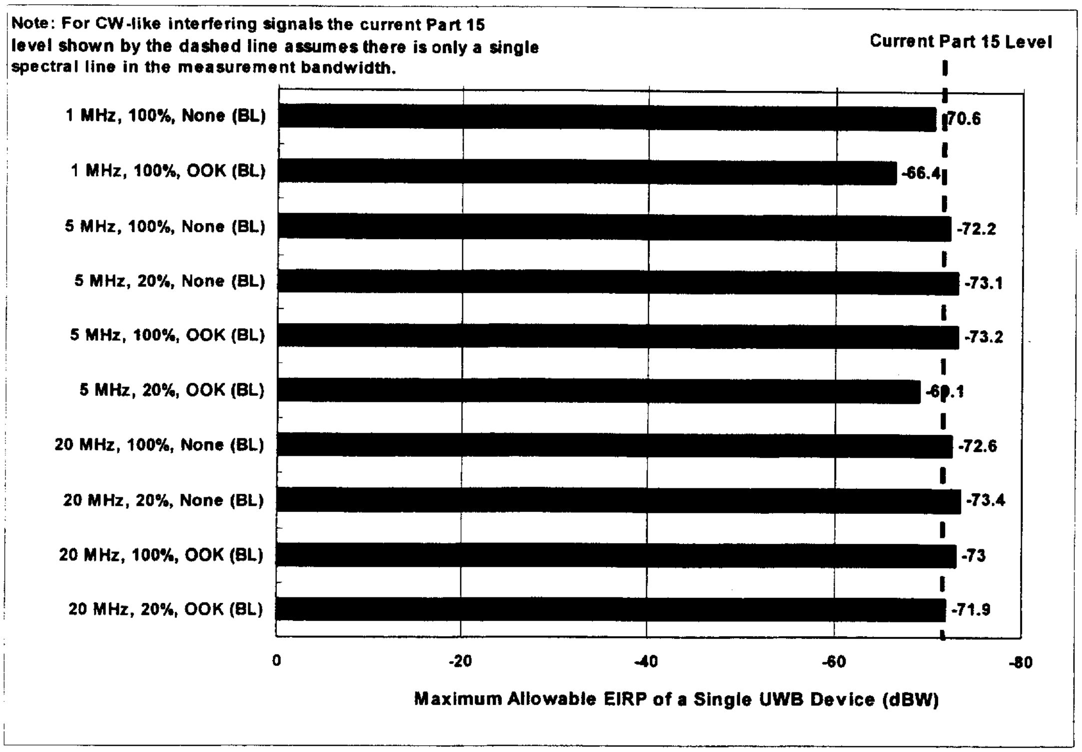

Figure 3-20. Analysis Results for Maritime Operational Scenario II: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (CW-Like UWB Signals)

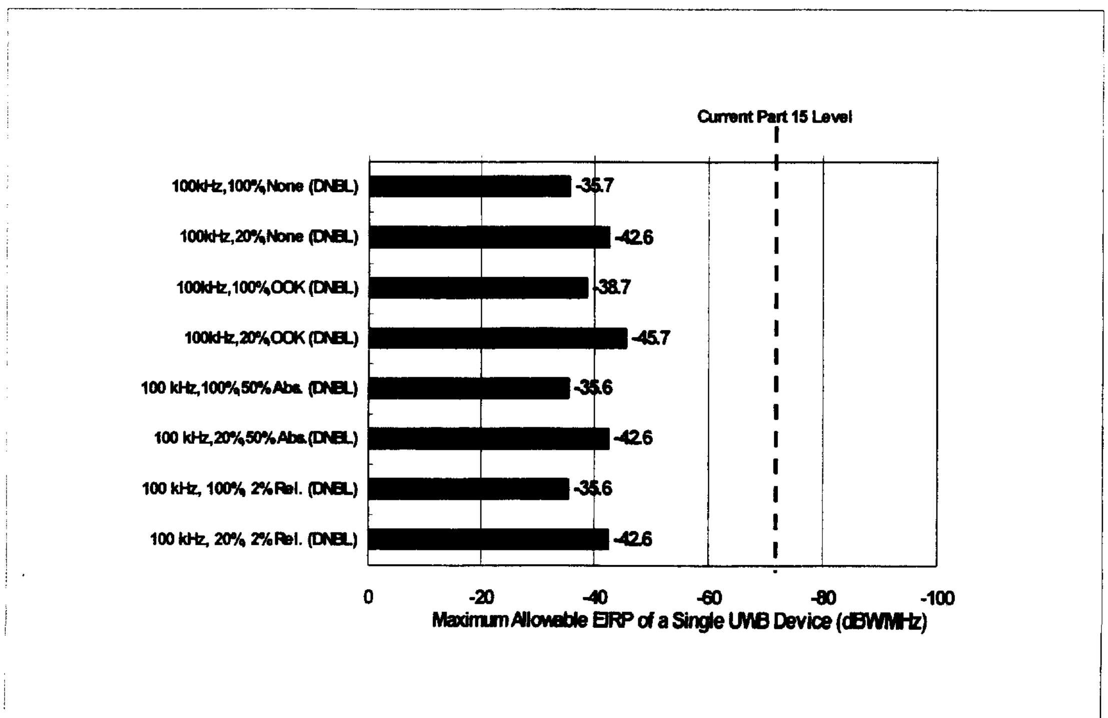

Figure 3-21. Analysis Results for Maritime Operational Scenario II: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices -Outdoor Operation (Pulse-Like UWB Signals)

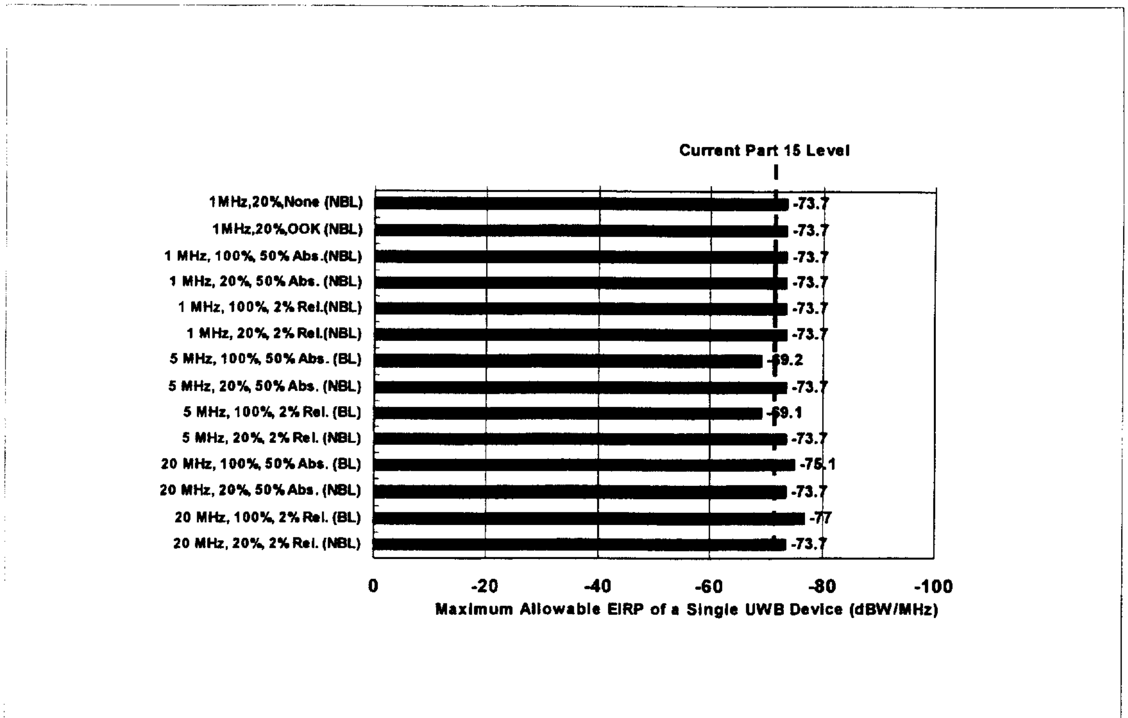

Figure 3-22. Analysis Results for Maritime Operational Scenario II: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices -Outdoor Operation (Noise-Like UWB Signals)

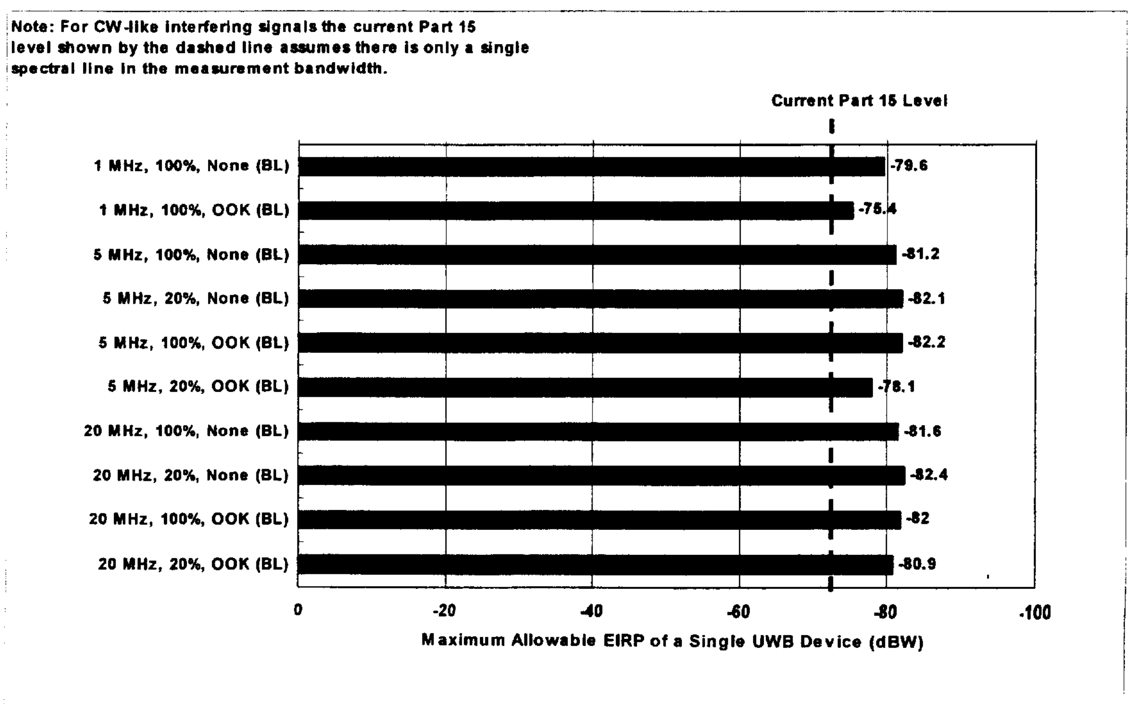

Figure 3-23. Analysis Results for Maritime Operational Scenario II: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (CW-Like UWB Signals)

3.3.3 Railway Applications

In the operational scenarios for the railway GPS applications, the narrowly-spaced correlator receiver architecture is considered. The analysis results for the narrowly-spaced correlator receiver architecture are given in Figures 3-24 through 3-29. The operational scenarios considered multiple UWB device interactions as well as indoor and outdoor UWB device operation. The values of maximum allowable EIRP shown in Figures 3-24 through 3-29 are for a single UWB device and are based on average power.

The values of maximum allowable EIRP that are required to protect the narrowly-spaced correlator receiver architecture considered in the railway operational scenarios will vary depending on the UWB signal parameters and whether the UWB devices are being used indoors or outdoors. The analysis results can be discussed in terms of the characterization of the UWB signal interference effects. As shown in Figures 3-24 and 3-27, the values of maximum allowable EIRP for UWB signals that have been characterized as causing pulse-like interference range from -53.9 to -43.8 dBW/MHz for indoor UWB device operation and from -55.4 to -45.3 dBW/MHz for outdoor UWB device operation. Figures 3-25 and 3-28 show that for UWB signals that have been characterized as causing noise-like interference, the values of maximum allowable EIRP range from -84 to -76.1 dBW/MHz for indoor UWB device operation and from -85.5 to -77.6 dBW/MHz for outdoor UWB device operation. Figures 3-26 and 3-29 show that for UWB signals that have been characterized as causing CW-like interference, the values of maximum allowable EIRP range from -90.6 to -83.6 dBW for indoor UWB device operation and from -92.1 to -85.1 dBW for outdoor UWB device operation.

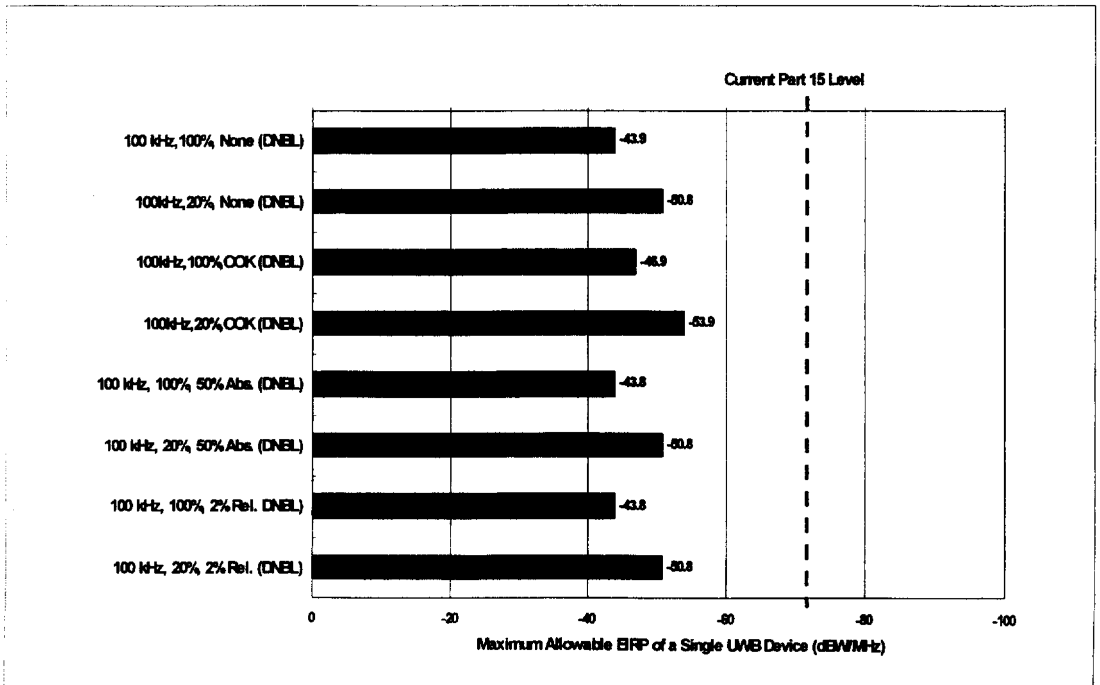

Figure 3-24. Analysis Results for Railway Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices -Indoor Operation (Pulse-Like UWB Signals)

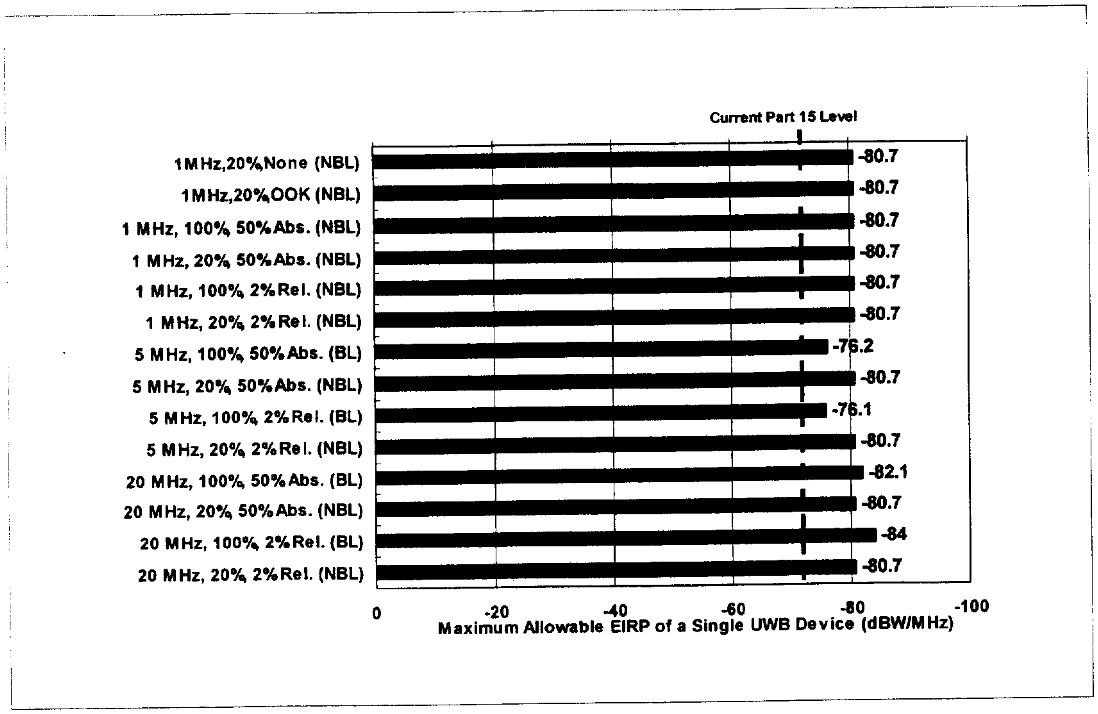

Figure 3-25. Analysis Results for Railway Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices -Indoor Operation (Noise-Like UWB Signals)

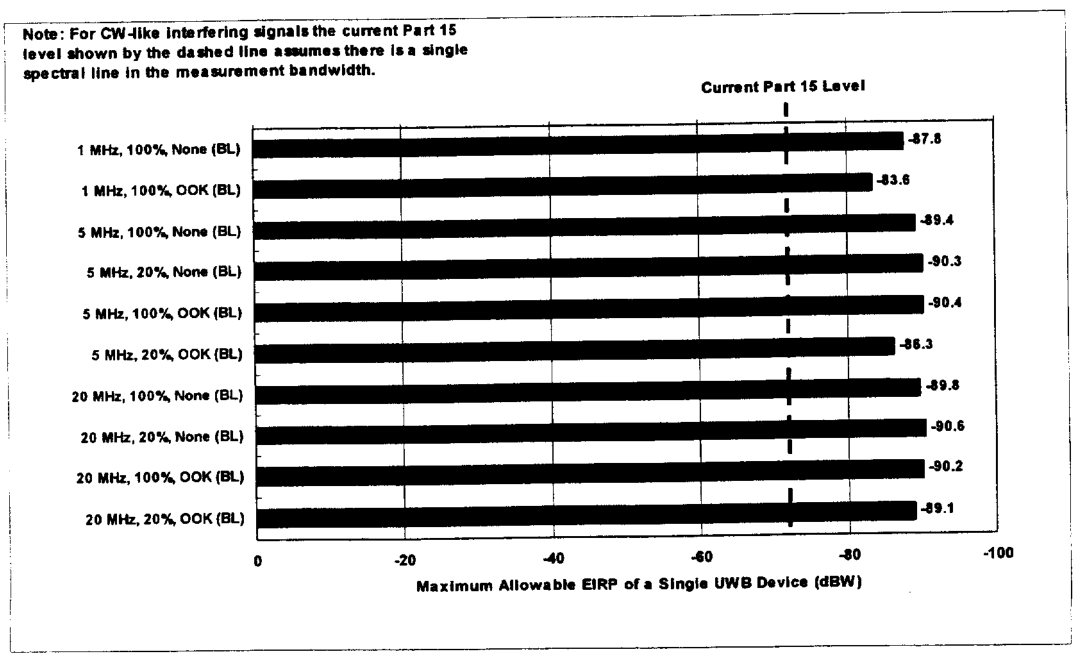

Figure 3-26. Analysis Results for Railway Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Indoor Operation (CW-Like UWB Signals)

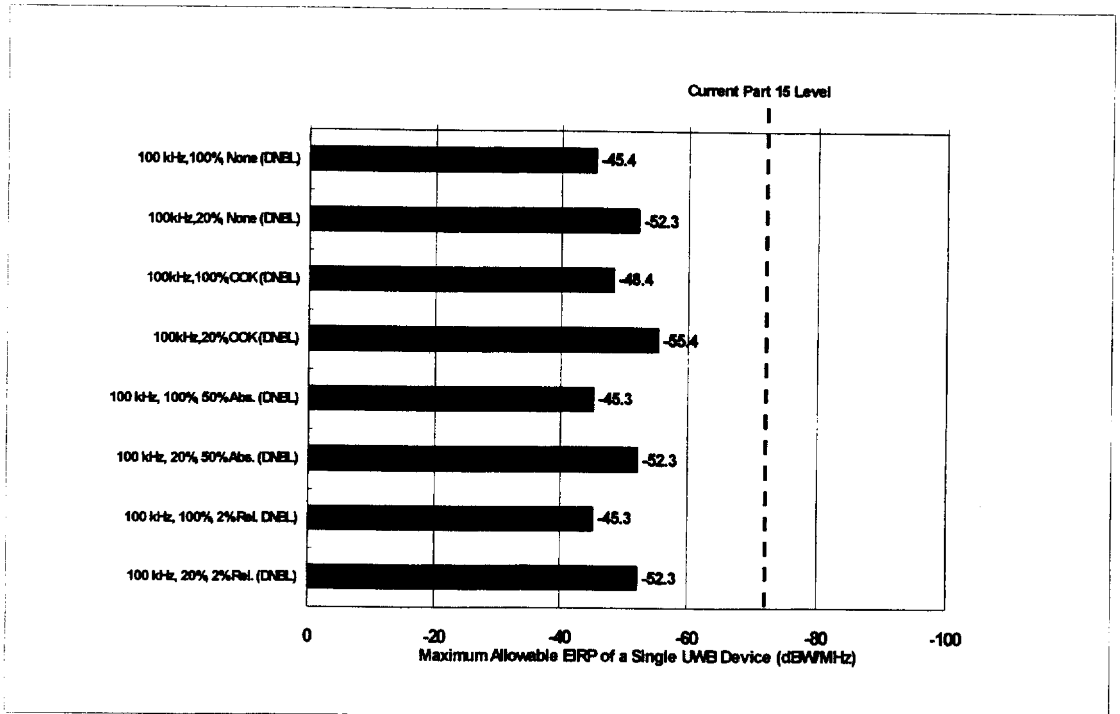

Figure 3-27. Analysis Results for Railway Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (Pulse-Like UWB Signals)

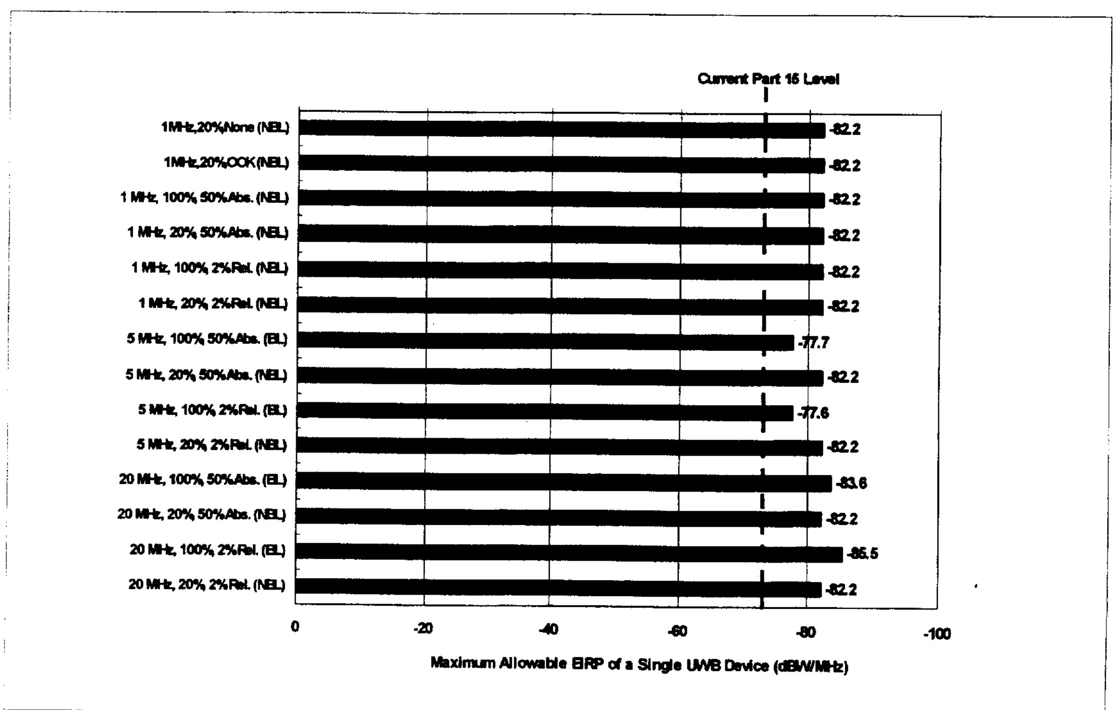

Figure 3-28. Analysis Results for Railway Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (Noise-Like UWB Signals)

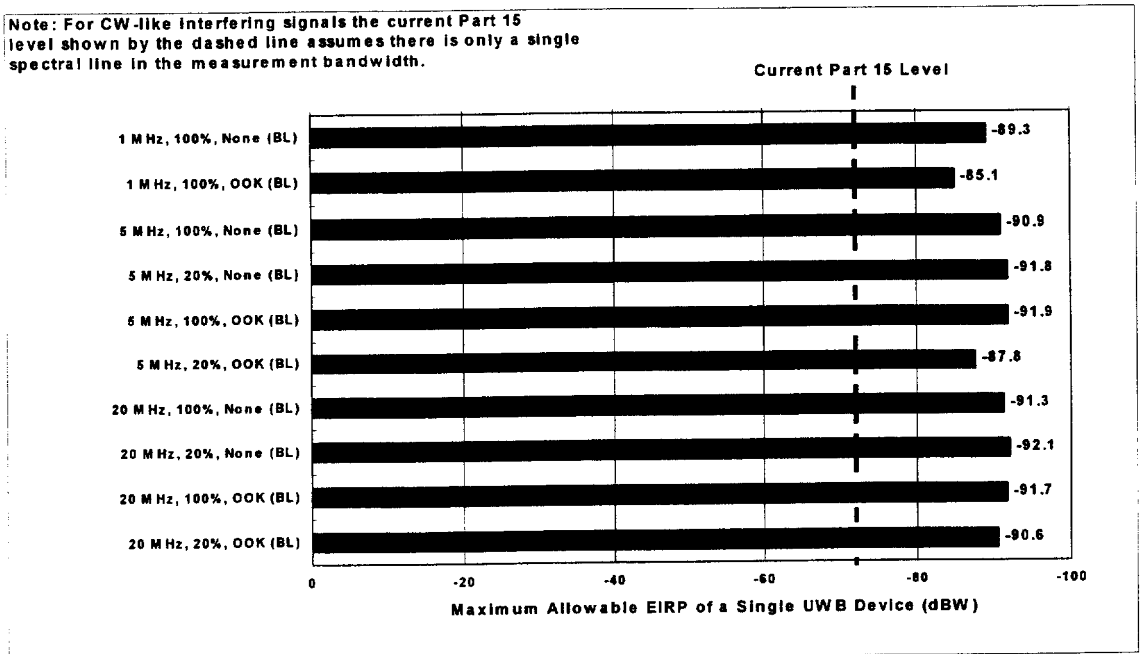

Figure 3-29. Analysis Results for Railway Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices - Outdoor Operation (CW-Like UWB Signals)

3.3.4 Surveying Applications

In the operational scenarios for the surveying GPS applications, the narrowly-spaced correlator receiver architecture is considered. The analysis results are given in Figures 3-30 through 3-35. The operational scenarios considered single-entry and multiple-entry UWB device interactions. The values of maximum allowable EIRP shown in Figures 3-30 through 3-35 are for a single UWB device and are based on average power. For the narrowly-spaced correlator receiver architecture the UWB signals have been characterized as causing pulse-like, noise-like, or CW-like interference. As shown in Figure 3-30, the maximum allowable EIRP for the UWB signals that were characterized as causing pulse-like interference range from -65.3 to -30.9 dBW/MHz for single-entry UWB device interactions. Figure 3-31 shows that the maximum allowable EIRP for the UWB signals that were characterized as causing noise-like interference range from -78.6 to -70.7 dBW/MHz for single-entry UWB device interactions. For the UWB signals that have been characterized as causing CW-like interference, Figure 3-32 shows that the maximum allowable EIRP ranges from -90 to -83 dBW for single-entry UWB device interactions. As shown in Figure 3-33, the maximum allowable EIRP for the UWB signals that have been characterized as causing pulse-like interference range from -53.4 to -43.3 dBW/MHz for multiple-entry UWB device interactions. Figure 3-34 shows that the maximum allowable EIRP for the UWB signals that have been characterized as causing noise-like interference range from -78.7 to -70.8 dBW/MHz for multiple UWB device interactions. For the UWB signals that have been characterized as causing CW-like interference, Figure 3-35 shows that the maximum allowable EIRP ranges from -90.1 to -83.1 dBW for multiple UWB device interactions.

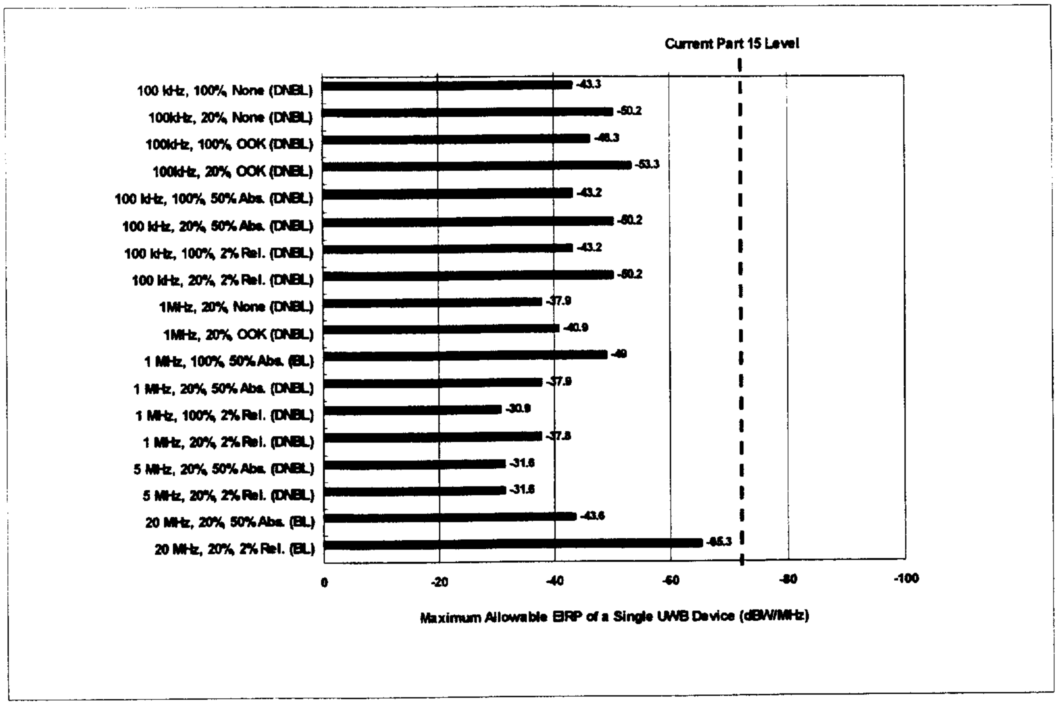

Figure 3-30. Analysis Results for the Surveying Operational Scenario: Narrowly-Spaced Correlator Receiver and Single UWB Device (Pulse-Like UWB Signals)

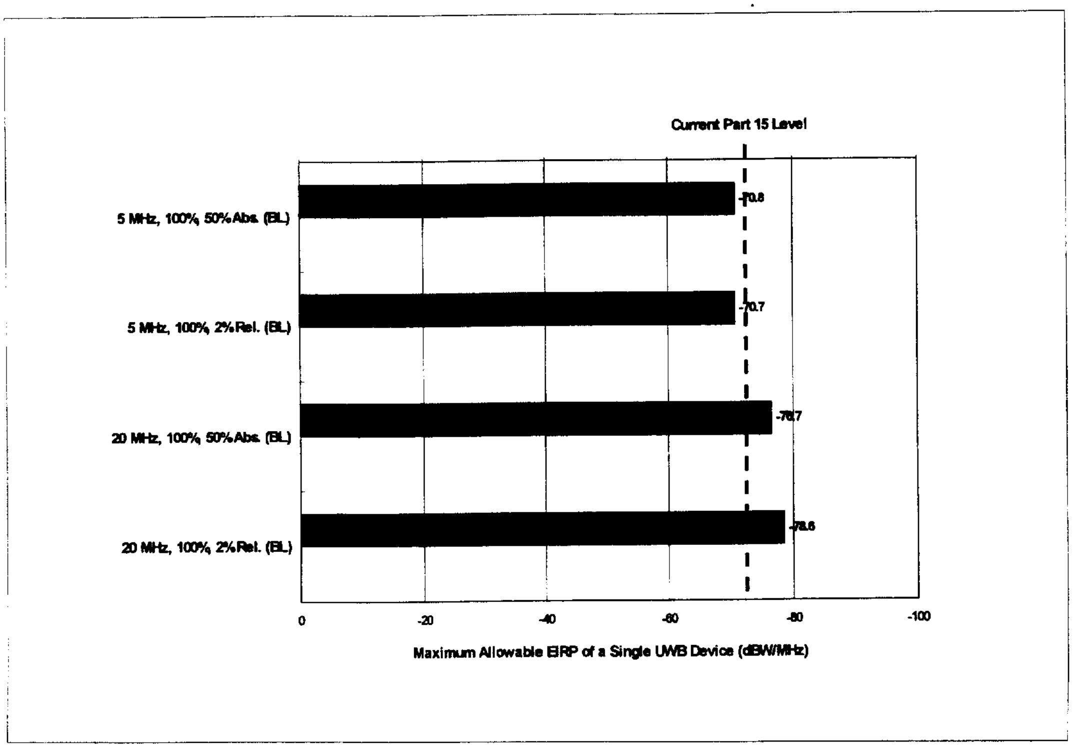

Figure 3-31. Analysis Results for the Surveying Operational Scenario: Narrowly-Spaced Correlator Receiver and Single UWB Device (Noise-Like UWB Signals)

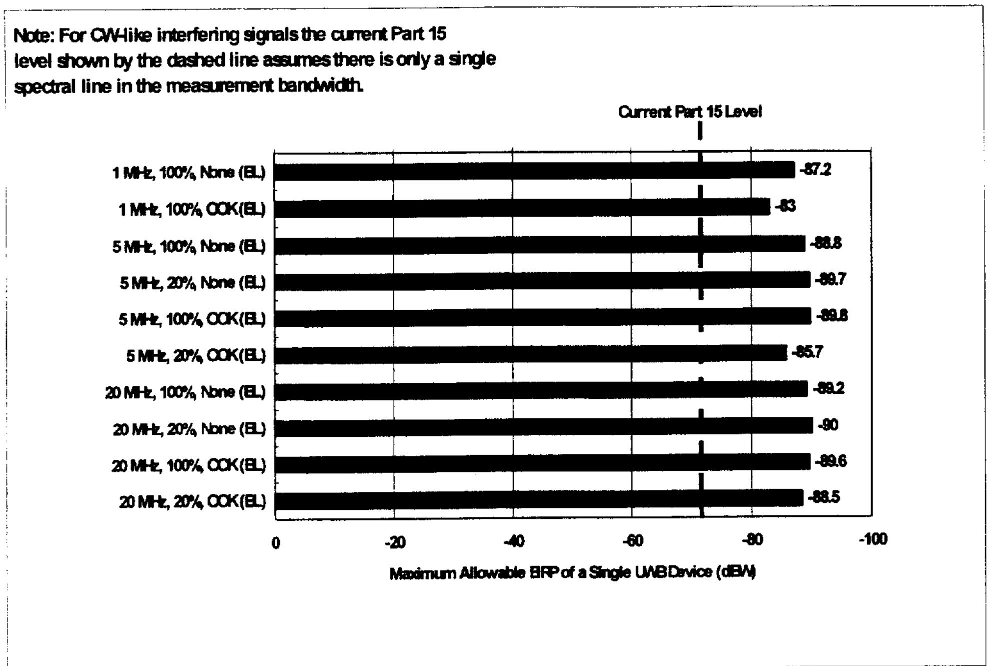

Figure 3-32. Analysis Results for Surveying Operational Scenario: Narrowly-Spaced Correlator Receiver and Single UWB Device (CW-Like UWB Signals)

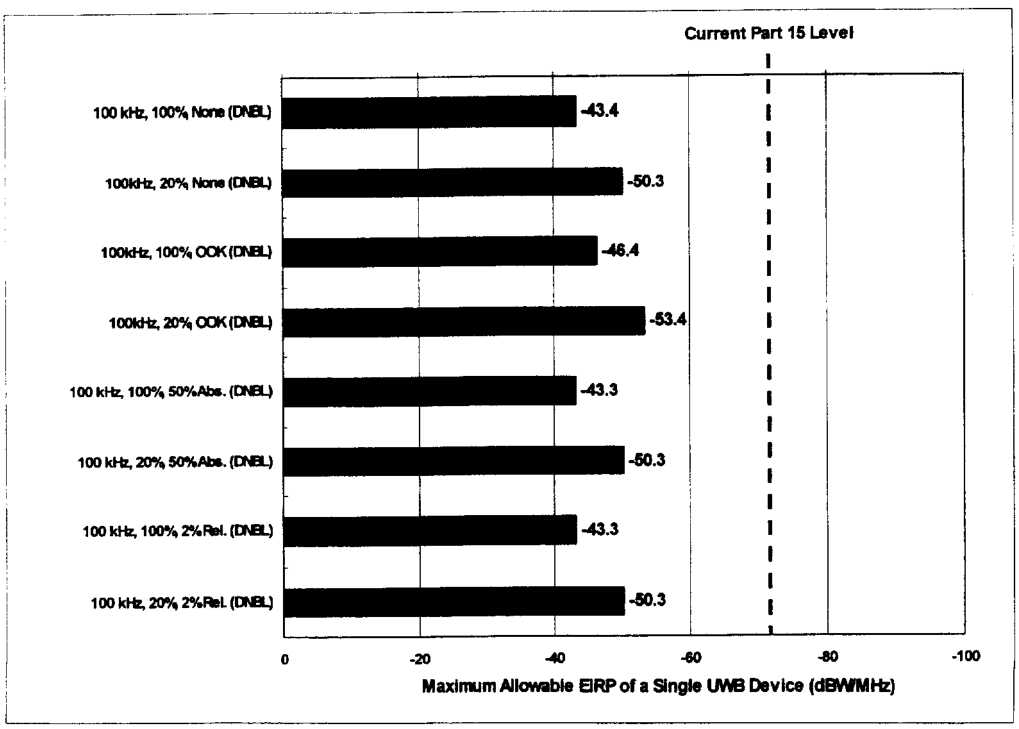

Figure 3-33. Analysis Results for the Surveying Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices (Pulse-Like UWB Signals)

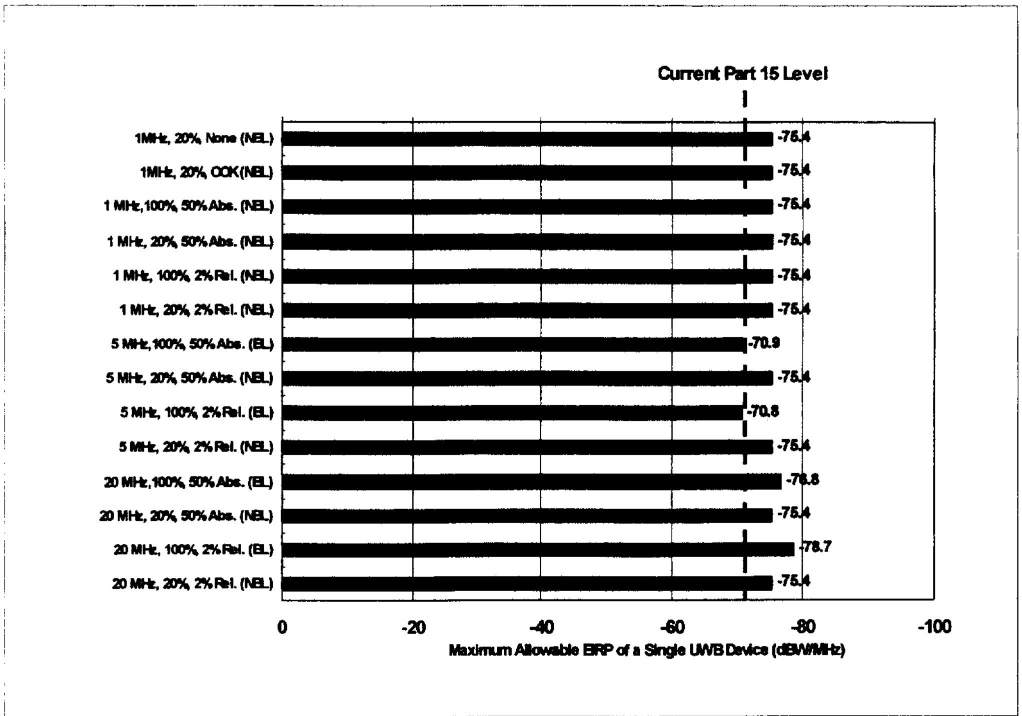

Figure 3-34. Analysis Results for the Surveying Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices (Noise-Like UWB Signals)

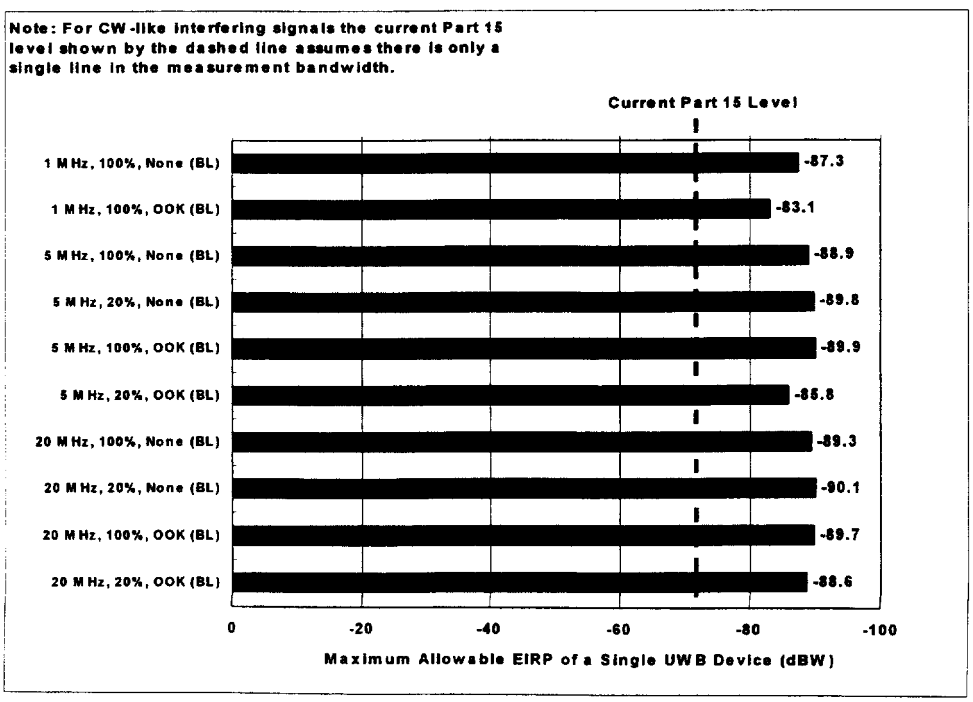

Figure 3-35. Analysis Results for the Surveying Operational Scenario: Narrowly-Spaced Correlator Receiver and Multiple UWB Devices (CW-Like UWB Signals)

3.3.5 Aviation Applications

In the aviation non-precision approach landing operational scenario, the TSO-C129a compliant C/A-code receiver architecture is considered. The analysis results for the non-precision approach operational; scenario using the TSO-C129a compliant C/A-code receiver architecture are given in Figures 3-36, 3-37, and 3-38. The values of maximum allowable EIRP shown in Figures 3-36 through 3-38 are for a single UWB device and are based on average power. As shown in Figure 3-36, for UWB signals that were characterized as causing pulse-like interference, the values of maximum allowable EIRP range from -58.2 to -38.2 dBW/MHz. For UWB signals that were characterized as causing noise-like interference, Figure 3-37 shows that the values of maximum allowable EIRP range from -89.3 to -79.8 dBW/MHz. As shown in Figure 3-38, the values of maximum allowable EIRP for UWB signals that were characterized as causing CW-like interference range from -88.1 to -78.5 dBW.

In the aviation en-route navigation operational scenario, the TSO-C129a compliant C/A-code receiver architecture is considered. The analysis results for the en-route navigation operational scenario using the TSO-C129a compliant C/A-code receiver architecture are given in Figures 3-39 and 3-40. The analysis results are presented in terms of the maximum EIRP as a function of active UWB device density. In this operational scenario, the aircraft is at an altitude of 1,000 feet. The operational scenarios consider both the indoor and outdoor operation of UWB devices. In these operational scenario it is assumed that there is a large enough number of UWB devices, such that independent of the parameters of the individual UWB signals the aggregate effect causes noise-like interference. The values of maximum allowable EIRP shown in Figures 3-39 and 3-40 are for a single UWB device and are based on average power. Figure 3-39 shows the analysis results when all of the UWB devices are operating outdoor. Figure 3-40 shows the analysis results when all of the UWB devices are operating indoors. As discussed earlier, determining the active number of UWB devices to consider when establishing the maximum allowable EIRP level is difficult and depends on factors such as population, the rate of penetration of the technology, and the appropriate activity factor. For example, assuming a population density of 2000 people per square kilometer and an assumed technology penetration of 10%, the UWB device density would be 200 devices per square kilometer. Based on this UWB device density, the EIRP of a single UWB device would be -84.9 dBW/MHz for outdoor UWB device operation (Figure 3-39) and -75.9 dBW/MHz for indoor UWB device operation (Figure 3-40). These values of maximum allowable EIRP were calculated under the assumption that the UWB devices are transmitting simultaneously. If an appropriate value for the activity factor could be determined, the calculated values of maximum allowable EIRP would be reduced accordingly.

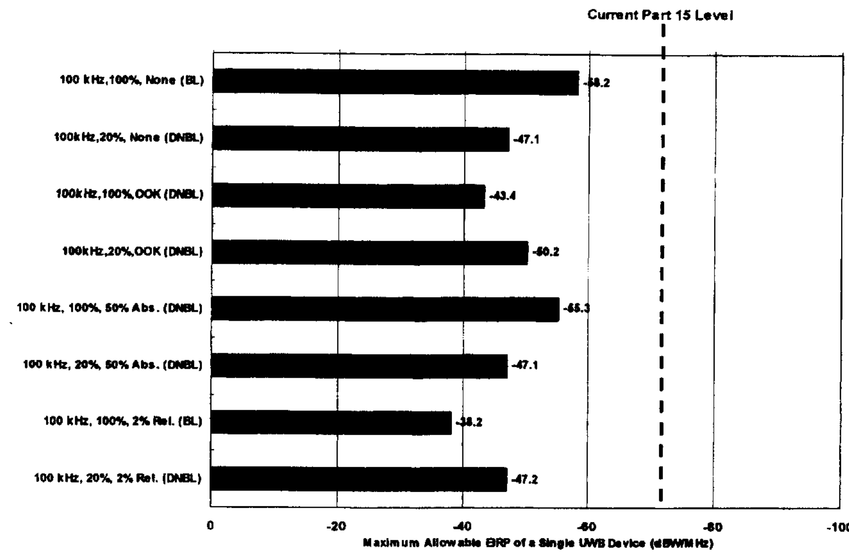

Figure 3-36. Analysis Results for Aviation (Non-Precision Approach Landing) Operational Scenario: TSO-C129a Compliant Receiver and Multiple UWB Devices (Pulse-Like UWB Signals)

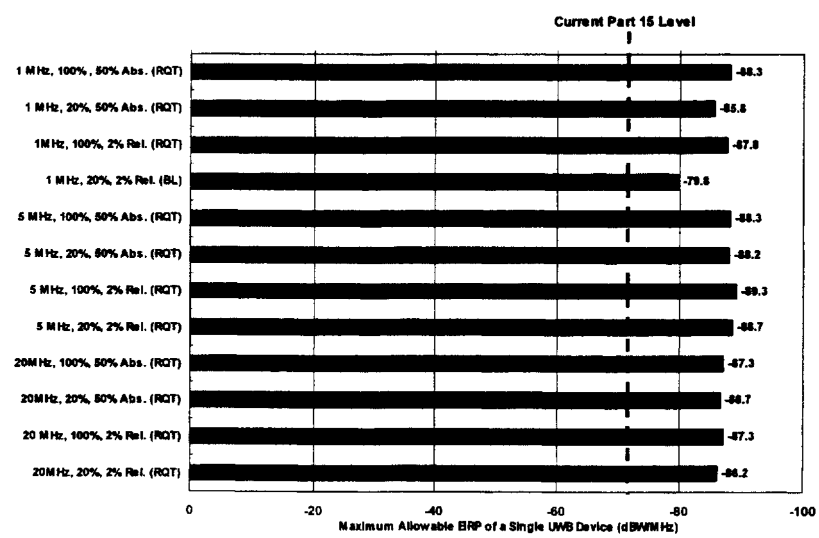

Figure 3-37. Analysis Results for Aviation (Non-Precision Approach Landing) Operational Scenario: TSO-C129a Compliant Receiver and Multiple UWB Devices (Noise-Like UWB Signals)

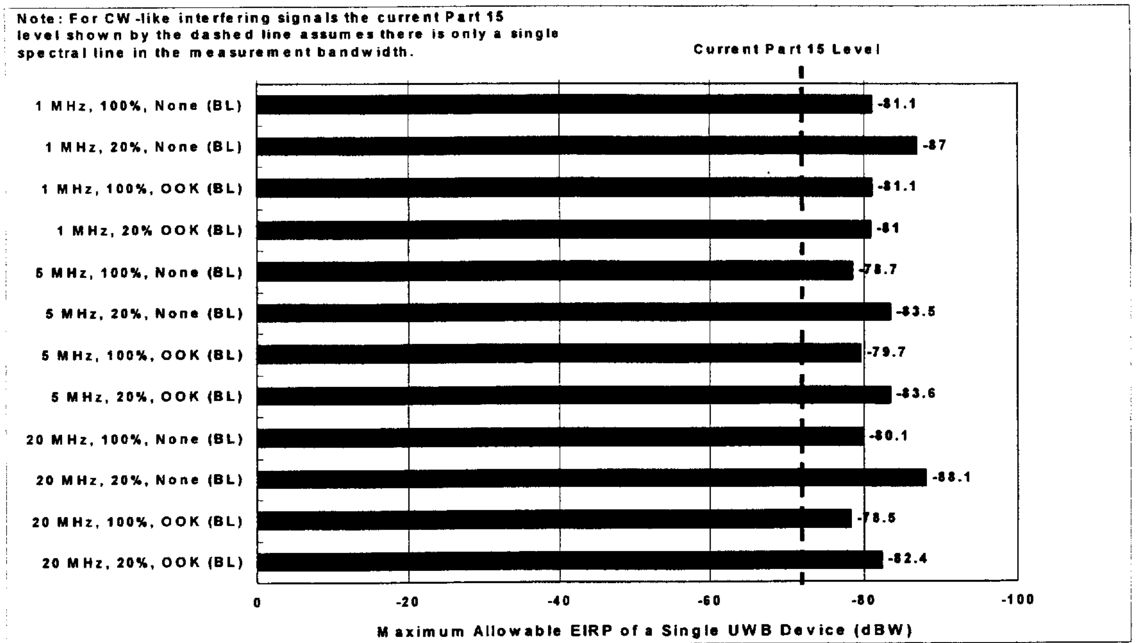

Figure 3-38. Analysis Results for Aviation (Non-Precision Approach Landing) Operational Scenario: TSO-C129a Compliant Receiver and Multiple UWB Devices (CW-Like UWB Signals)

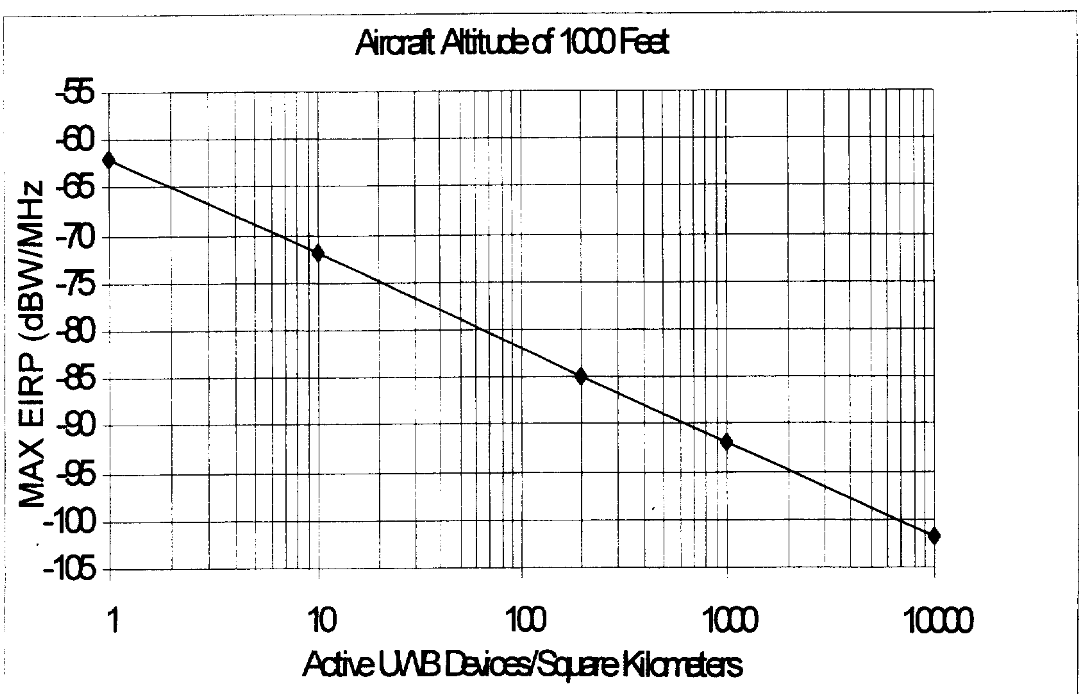

Figure 3-39. Analysis Results for Aviation (En-Route Navigation) Operational Scenario: TSO-C129a Compliant Receiver and Multiple UWB Devices - Outdoor Operation

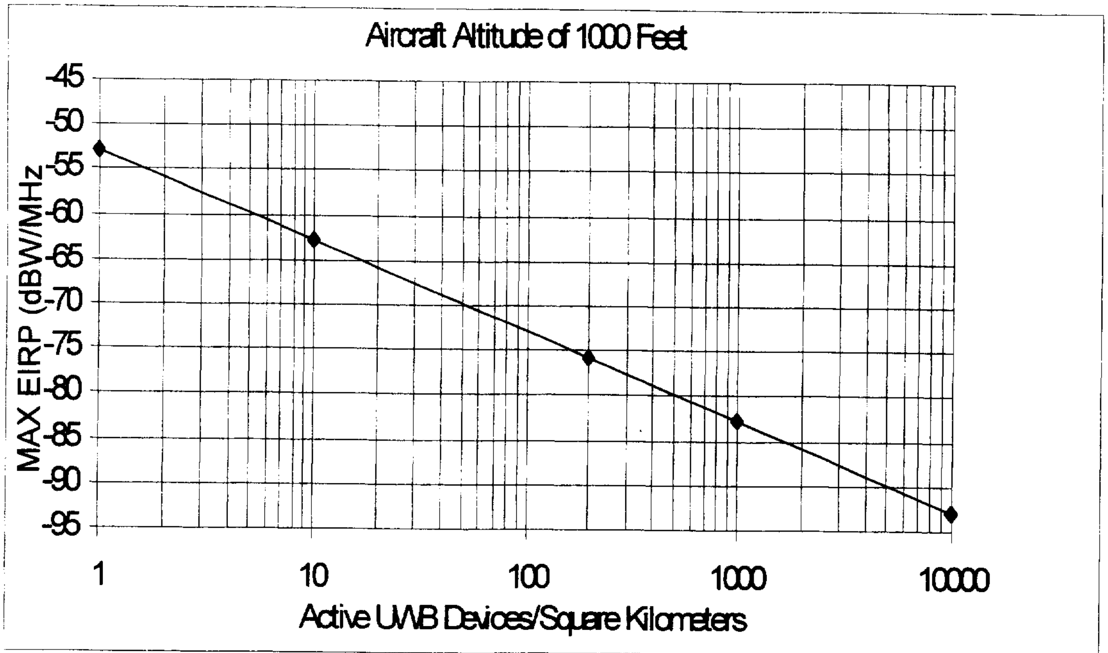

Figure 3-40. Analysis Results for Aviation (En-Route Navigation) Operational Scenario: TSO-C129a Compliant Receiver and Multiple UWB Devices - Indoor Operation

3.4 DISTANCE SEPARATION ANALYSIS

Section 15.209 of the FCC's rules establishes a field strength limit for intentional radiators above 1000 MHz of 500 microvolts/meter (measured in a 1 MHz bandwidth) at a reference distance of 3 meters. This field strength emission limit can be converted to an EIRP level of -71.3 dBW/MHz.[83] In this section, the measured UWB interference thresholds will be used to determine the distance separations that are required to preclude interference to different GPS receiver architectures, if the UWB device is operating at the current Part 15 level of -71.3 dBW/MHz. The interference thresholds for both single-entry and multiple-entry (aggregate) UWB device interactions are considered. For the single-entry UWB device interactions, the distance separations are computed for each UWB signal permutation. For the multiple-entry UWB device interactions, the specific measurement cases and interference thresholds analyzed are documented in NTIA Report 01-45. The UWB interference thresholds are based on measurements performed by NTIA's Institute for Telecommunication Sciences.

The following equation is used to compute the distance separation:

$$D_{sep} = 10^{(EIRP+Gr-20\,LogF+27.55+10\,LogN+Lman+Lallot+Lsafety-I_T)/20} \tag{12}$$

[83] The field strength emission limits can be converted to an EIRP level in dBW using the following equation: EIRP(dBW) = E_o(dBμV/m) + 20 Log D(m) -134.8.

where:

D_{sep} is the distance separation between the UWB device and the GPS receiver that would preclude interference (m);
EIRP is the current Part 15 emission level (dBW/MHz);
Gr is the GPS receive antenna gain in the direction of the UWB device (dBi);
F is the GPS center frequency (MHz);
N is the number of UWB devices for the noise-like multiple-entry UWB device interactions;
Lman is the factor to account for manufacturer variations in GPS receivers (dB);
Lallot is the factor for interference allotment (dB);
Lsafety is the aviation safety margin (dB);
I_T is the interference threshold of the UWB signal at the input of the GPS receiver (dBW or dBW/MHz).

To compute the distance separation, the free-space propagation loss model is used. Based on Equation 4, using 3 meters for the GPS and UWB antenna heights, for land-based GPS receiver applications, the use of the free-space propagation model is valid for all distance separations less than 568 meters. The free-space propagation model is also applicable to the aviation GPS receiver applications.

Table 3-15 provides the parameters that are used in the distance separation analysis.

Table 3-15. Parameters Used in the Distance Separation Analysis

Parameter	Value
EIRP	-71.3 dBW/MHz (Part 15 Level)
Gr	3, 0, and -4.5 dBi (non-aviation) -10 dBi (aviation)
F	1575.42 MHz
Lman	3 dB
Lallot	3 dB (non-aviation) 10 dB (aviation)
Lsafety	6 dB (aviation)
I_T[84]	**Single-Entry:** Table 3-13 (Narrowly-Spaced Correlator), Table 3-14 (TSO-C129a Compliant), Table 3-16 (C/A Code), Table 3-17 (Semi-Codeless) **Multiple-Entry:** Table 3-18

[84]The interference thresholds for CW-like interfering signals use a worst case assumption where there is only one spectral line within the measurement bandwidth.

The single-entry UWB interference thresholds for the GPS C/A code receiver architecture used in this analysis are provided in Table 3-16.[85]

The single-entry UWB interference thresholds for the semi-codeless receiver architecture used in this analysis are provided in Table 3-17.[86]

Prior to using the interference thresholds for the multiple entry interactions that are presented in Table 2-4 of NTIA Report 01-45[87] in the analysis, the values must be adjusted to: 1) convert from a 20 MHz measurement bandwidth to a 1 MHz analysis bandwidth; 2) convert from dBm to dBW; 3) determine the power contained in a spectral line for CW-like signals; 4) account for the gate on-time relative to the total time. The adjusted values of the UWB interference threshold are given in Table 3-18.

[85] NTIA Report 01-45 at 3-26.

[86] *Id.* at 3-27.

[87] *Id.* at 2-7.

TABLE 3-16. Single-Entry UWB Interference Thresholds for C/A Code Receiver Architectures

Interfering Signal Structure	UWB Interference Threshold	GPS Receiver Criteria
Broadband Noise	-134.5 dBW/MHz	Reacquisition
0.1 MHz PRF, No Mod, 100% Gate	-112.6 dBW/MHz	Break-Lock
0.1 MHz PRF, No Mod, 20% Gate	-106.5 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, OOK, 100% Gate	-102.6 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, OOK. 20% Gate	-109.4 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, 50% abs, 100% Gate	-100 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, 50% abs, 20% Gate	-107 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, 2% rel, 100% Gate	-100 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, 2% rel, 20% Gate	-107 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
1 MHz PRF, No Mod, 100% Gate	-143.7 dBW	Break-Lock
1 MHz PRF, No Mod, 20% Gate	-97.6 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
1 MHz PRF, OOK, 100% Gate	-121.2 dBW/MHz	Break-Lock
1 MHz PRF, OOK, 20% Gate	-101.1 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
1 MHz PRF, 50% abs, 100% Gate	-113 dBW/MHz	Reacquisition
1 MHz PRF, 50% abs, 20% Gate	-97.5 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
1 MHz PRF, 2% rel, 100% Gate	-131 dBW/MHz	Reacquisition
1 MHz PRF, 2% rel, 20% Gate	-97 dBW/MHz	Reacquisition
5 MHz PRF, No Mod, 100% Gate	-145.5 dBW	Break-Lock
5 MHz PRF, No Mod, 20% Gate	-145.2 dBW	Break-Lock
5 MHz PRF, OOK, 100% Gate	-144.5 dBW	Break-Lock
5 MHz PRF, OOK, 20% Gate	-144.2 dBW	Break-Lock
5 MHz PRF, 50% abs, 100% Gate	-137 dBW/MHz	Reacquisition
5 MHz PRF, 50% abs, 20% Gate	-105 dBW/MHz	Reacquisition
5 MHz PRF, 2% rel, 100% Gate	-136.5 dBW/MHz	Reacquisition
5 MHz PRF, 2% rel, 20% Gate	-89 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
20 MHz PRF, No Mod, 100% Gate	-145 dBW	Break-Lock
20 MHz PRF, No Mod, 20% Gate	-145.8 dBW	Break-Lock
20 MHz PRF, OOK, 100% Gate	-144.5 dBW	Break-Lock
20 MHz PRF, OOK, 20% Gate	-146.3 dBW	Break-Lock
20 MHz PRF, 50% abs, 100% Gate	-138 dBW/MHz	Reacquisition
20 MHz PRF, 50% abs, 20% Gate	-135 dBW/MHz	Reacquisition
20 MHz PRF, 2% rel, 100% Gate	-136 dBW/MHz	Reacquisition
20 MHz PRF, 2% rel, 20% Gate	-133 dBW/MHz	Reacquisition

TABLE 3-17. Single-Entry UWB Interference Thresholds for Semi-Codeless Receiver Architectures

Interfering Signal Structure	UWB Interference Threshold	GPS Receiver Criteria
Broadband Noise	-150 dBW/MHz	Reacquisition
0.1 MHz PRF, No Mod, 100% Gate	-118 dBW/MHz	Reacquisition
0.1 MHz PRF, No Mod, 20% Gate	-116.5 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, OOK, 100% Gate	-112 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, OOK. 20% Gate	-118.5 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, 50% abs, 100% Gate	-121 dBW/MHz	Reacquisition
0.1 MHz PRF, 50% abs, 20% Gate	-116 dBW/MHz	Did Not Break-Lock At Maximum UWB Power
0.1 MHz PRF, 2% rel, 100% Gate	-119 dBW/MHz	Reacquisition
0.1 MHz PRF, 2% rel, 20% Gate	-138 dBW/MHz	Reacquisition
1 MHz PRF, 50% abs, 100% Gate	-151 dBW/MHz	Reacquisition
1 MHz PRF, 50% abs, 20% Gate	-132 dBW/MHz	Reacquisition
1 MHz PRF, 2% rel, 100% Gate	-149 dBW/MHz	Reacquisition
1 MHz PRF, 2% rel, 20% Gate	-134 dBW/MHz	Reacquisition
5 MHz PRF, 50% abs, 100% Gate	-151 dBW/MHz	Reacquisition
5 MHz PRF, 50% abs, 20% Gate	-151 dBW/MHz	Reacquisition
5 MHz PRF, 2% rel, 100% Gate	-149 dBW/MHz	Reacquisition
5 MHz PRF, 2% rel, 20% Gate	-142.5 dBW/MHz	Reacquisition
20 MHz PRF, No Mod, 100% Gate	-145 dBW/MHz	Break-Lock
20 MHz PRF, No Mod, 20% Gate	-148 dBW/MHz	Break-Lock
20 MHz PRF, OOK, 100% Gate	-137 dBW/MHz	Break-Lock
20 MHz PRF, OOK, 20% Gate	-146 dBW/MHz	Break-Lock
20 MHz PRF, 50% abs, 100% Gate	-149.5 dBW/MHz	Reacquisition
20 MHz PRF, 50% abs, 20% Gate	-148 dBW/MHz	Reacquisition
20 MHz PRF, 2% rel, 100% Gate	-149.5 dBW/MHz	Reacquisition
20 MHz PRF, 2% rel, 20% Gate	-143.5 dBW/MHz	Reacquisition

TABLE 3-18. UWB Interference Thresholds for the Multiple-Entry Measurement Cases

PRF (MHz)	Gating Percentage	Modulation	Number of UWB Signal Generators	UWB Interference Threshold	GPS Receiver Criteria
10	100	Dithering 2% Rel.	6	-137.5 dBW/MHz	Reacquisition
10	20	Dithering 2% Rel.	6	-136 dBW/MHz	Reacquisition
10 3 3	100 100 20	None None Dithering 2% Rel.	2 1 3	-149.6 dBW	Reacquisition
3 3	20 20	None Dithering 2% Rel.	4 2	-143.5 dBW	Reacquisition
1	100	Dithering 2% Rel.	1	-131 dBW/MHz	Reacquisition
1	100	Dithering 2% Rel.	2	-136 dBW/MHz	Reacquisition
1	100	Dithering 2% Rel.	3	-136 dBW/MHz	Reacquisition
1	100	Dithering 2% Rel.	4	-136 dBW/MHz	Reacquisition
1	100	Dithering 2% Rel.	5	-137 dBW/MHz	Reacquisition
1	100	Dithering 2% Rel.	6	-136 dBW/MHz	Reacquisition

Figures 3-41, 3-42, and 3-43 present the distance separations that would preclude interference from single-entry UWB device interactions as a function of UWB device PRF for the C/A code, semi-codeless, and narrowly-spaced correlator receiver architectures. The distances shown correspond to the maximum distance separation for all of the signal permutations employing that particular PRF. The three curves correspond to the different values of GPS antenna gain considered in this analysis.

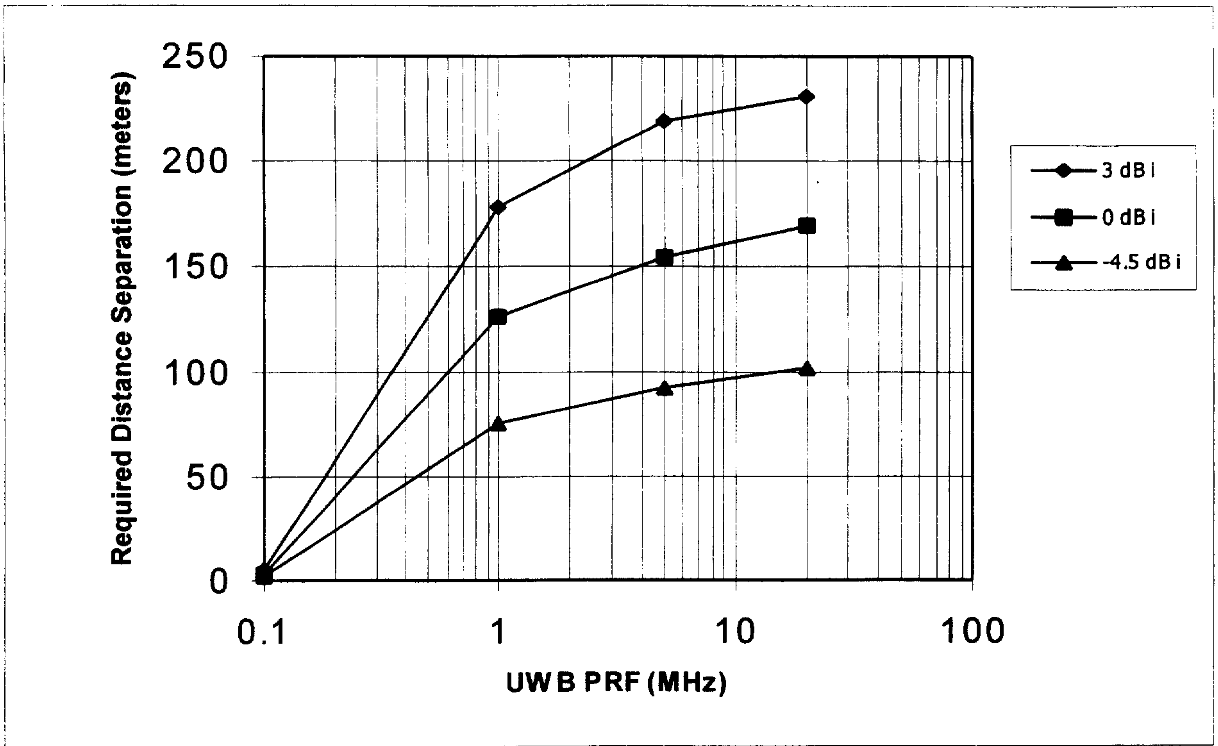

Figure 3-41. Calculated Distance Separations for Single-Entry UWB Device Interactions (C/A Code Receiver Architecture) Based on the Current Part 15 Emission Level

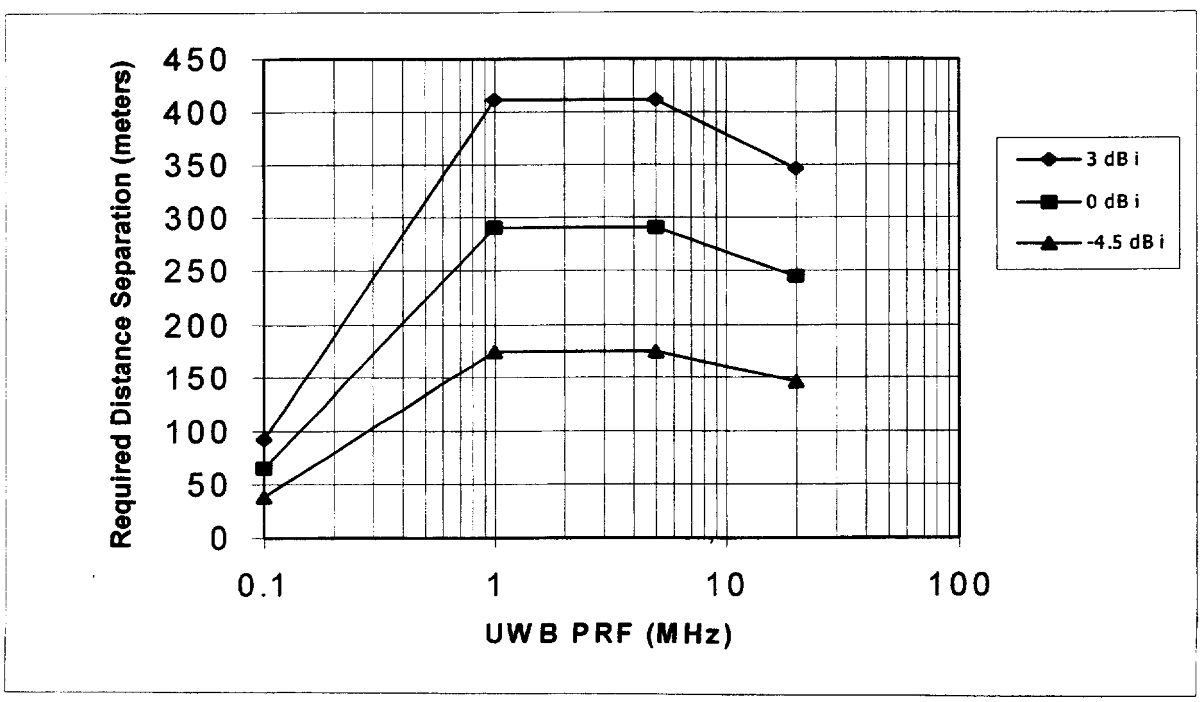

Figure 3-42. Calculated Distance Separations for Single-Entry UWB Device Interactions (Semi-Codeless Receiver Architecture) Based on the Current Part 15 Emission Level

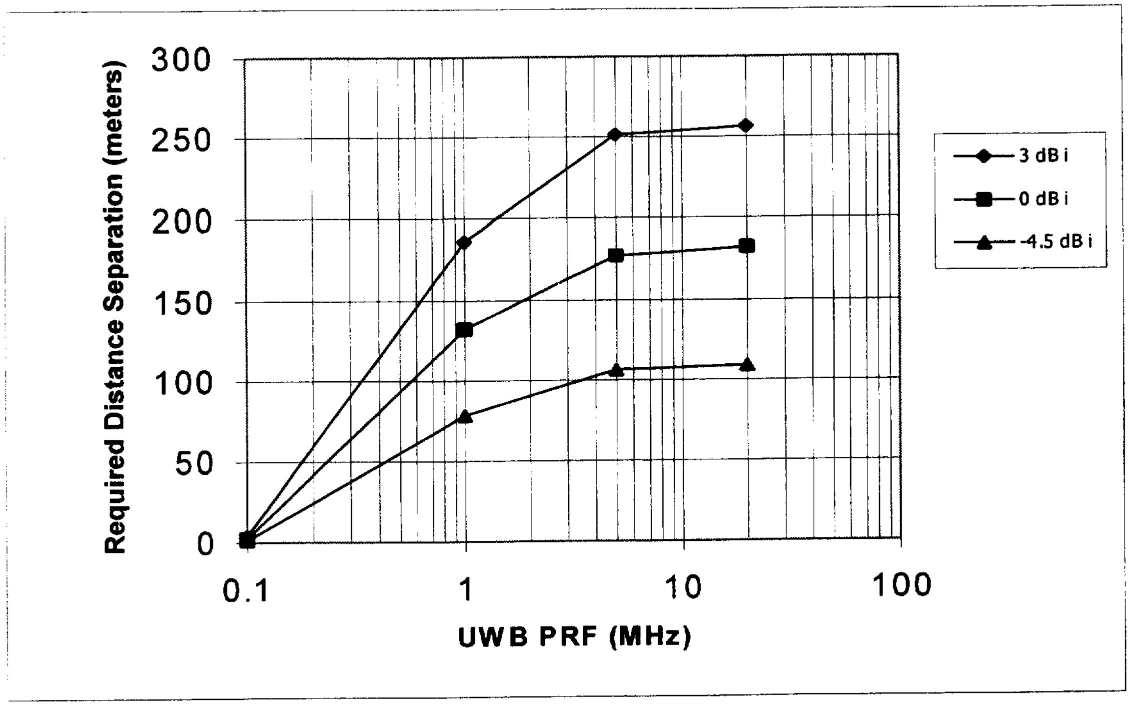

Figure 3-43. Calculated Distance Separations for Single-Entry UWB Device Interactions (Narrowly-Spaced Correlator Receiver Architecture) Based on the Current Part 15 Emission Level

Table 3-19 gives the distance separations for the multiple-entry UWB device interactions for the C/A code receiver architecture.

Figure 3-44 presents the distance separations that would preclude interference from single-entry UWB device interactions as a function of UWB device PRF for the TSO-C129a compliant C/A code GPS receiver architecture. The distances shown correspond to the maximum distance separation for all of the signal permutations employing that particular PRF.

The spreadsheets used to determine the distance separations given in Figures 3-41 through 3-44 and Table 3-19 are provided in Appendix B.

TABLE 3-19. Calculated Distance Separations to Preclude Interference from Multiple-Entry UWB Device Interactions Based on the Current Part 15 Emission Limit (C/A Code Receiver Architecture)

PRF	Gating Percent	Modulation	Number of UWB Signal Generators	Distance Separation (meters)		
				Gr = 3 dBi	Gr = 0 dBi	Gr = -4.5 dBi
10 MHz	100	Dithering 2% Rel.	6	213	151	90
10 MHz	20	Dithering 2% Rel.	6	180	127	76
10 MHz 3 MHz 3 MHz	100 100 20	None None Dithering 2% Rel.	2 1 3	351	248	148
3 MHz 3 MHz	20 20	None Dithering 2% Rel.	4 2	174	123	73
1 MHz	100	Dithering 2% Rel.	1	41	29	17
1 MHz	100	Dithering 2% Rel.	2	104	73	44
1 MHz	100	Dithering 2% Rel.	3	127	90	54
1 MHz	100	Dithering 2% Rel.	4	147	104	62
1 MHz	100	Dithering 2% Rel.	5	184	130	78
1 MHz	100	Dithering 2% Rel.	6	180	127	76

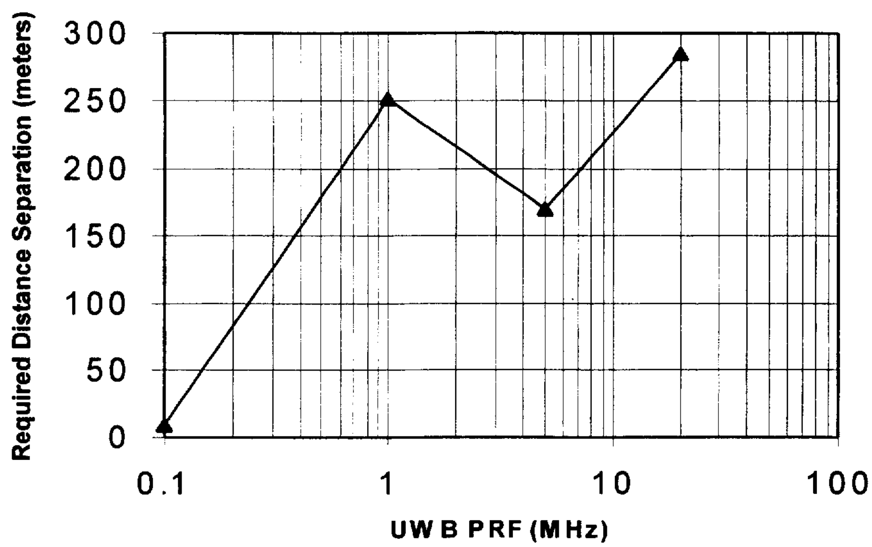

Figure 3-44. Calculated Distance Separations for Single-Entry UWB Device Interactions (TSO-C129a Compliant C/A Code Receiver Architecture) Based on the Current Part 15 Emission Level